A HISTORY OF STREAM POLLUTION ASSESSMENT AND CONTROL — NORTH SASKATCHEWAN RIVER 1950's to 1980's

Alberta
ENVIRONMENT

A HISTORY OF STREAM POLLUTION ASSESSMENT AND CONTROL - NORTH SASKATCHEWAN RIVER

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September 1984

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ASSESSMENT AND CONTROL -
NORTH SASKATCHEWAN RIVER
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The improvement in water quality has been due to two major factors.

Waste treatment has been installed for all wastes flowing to the North Saskatchewan. The City of Edmonton, which is the largest contributor of waste water, provides secondary treatment of city sewage. The quality of industrial effluent meets high standards, which are set out in "permits to construct" and "licences to operate" issued by the Department of the Environment.

Another factor in water quality improvement is the increase in the, river flows during winter. Low river flows and ice cover create a situation in which the permissible loadings to the river are very low. The construction of the Brazeau Dam and of the Bighorn Dam assured winter flows which are four or five times the minimum which had occurred in the past.

A considerable portion of the report is descriptive, sufficient data are provided to give only a general measure of the "health" of the North Saskatchewan River.

It is hoped that this perspective of the past may aid in deciding the requirements of the future.

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ACKNOWLEDGEMENTS

This brief history of stream pollution, assessment and control, as based on the North Saskatchewan River, was prepared under contract with the Pollution Control Division, Alberta Environment. The assistance of the staff is gratefully acknowledged.

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INTRODUCTION

In 1949, the Department of Health of the Province of Alberta instituted a stream pollution control program. The Minister of Health was Dr. W. W. Cross. The Deputy Minister of Health at the time was Dr. A. Sommerville. Within the Department of Health was one provincial Sanitary Engineer, Mr. D. R. Stanley (now Dr. D. R. Stanley).

The concept of stream pollution control was, at that time (1949), a relatively new idea. While there had been some studies and application of control measures in the eastern United States, England and Europe, waste treatment was carried out in only a few cities. During the war years, 1939 to 1945, priority was given to the production of war materials. At the same time, the population of most cities increased. Existing waste treatment facilities (if present) were overloaded, and often all but the minimum flows were bypassed. The City of Edmonton was no exception.

In the late 1920's and early 1930's, sewage treatment plants had been built to serve the City of Edmonton. One of these, the number 1 plant, was located on the north side of the North Saskatchewan River below the Dawson Bridge. It provided fine screening and primary sedimentation of sewage. It served the north side of the city as well as Swifts, Burns and Canada Packers meat packing plants. This was at a time when packing plants provided no pretreatment of their wastes.

A second treatment plant, number 3, was located at what is now Queen Elizabeth Park. It provided secondary treatment by the passage of sewage through layers of wooden slats beneath which compressed air was released - a contact aeration unit. Sludge digestion was also

provided. Dr. K. Imhoff, after whom Imhoff tanks are named, was a consultant on the plant design. The plant produced a good effluent at design flows. It served the south side - University area and Gainer's packing plant. The outfall from this plant was almost directly across the river from the present (1983) Rossdale water treatment plant.

In addition, the number 4 plant located on the south side of the North Saskatchewan provided primary sewage treatment for the Mill Creek area. The reader may note that there was no number 2 treatment plant; it must have been phased out earlier.

In the following period of 1939 to 1955 there was no further construction of treatment facilities. Aggravation of the pollution problem lay in the combined sewer system which required that, even with low rainfall intensities, sewage be bypassed. As a result, much raw sewage flowed into the North Saskatchewan River. The 1947 oil find at Leduc resulted in the construction of oil refineries. Industrial wastes, aside from packing plant wastes which passed through the city treatment facilities, were not a problem until the early 1950's, when many other industrial plants were constructed. In addition to industrial wastes, the industrial growth had the secondary effect of creating a greater population for the City of Edmonton. The population of 160,000 in 1951 rose to 250,000 in 1955.

Prior to 1950, there was no rational pollution control. The only control legislation was the Federal Fisheries Act. The relevant sections stated that there should be no pollution of fisheries waters. Pollution was not defined, and because no testing of the quantity of pollution was carried out, pollution was ignored. There were for example, no rules or limits on wastes disposal from pulp mills.

Little, if any, treatment of wastes was provided. Where treatment of wastes was provided, there was no check on treatment efficiency, no licencing, no effluent quality standards, no testing of stream water quality. Treatment facilities often deteriorated or were overloaded. There was no real objective to meet.

THE POLLUTION CONTROL PROGRAM

In 1949, a stream pollution control program was begun. The first efforts were concentrated on:

a) assessment of stream conditions;

b) assessment and treatment facilities and quality of effluents; and

c) development of a rational method of pollution control.

The program was at first staffed by one person, P. H. Bouthillier. Equipment consisted of a Ford Panel which was equipped for field tests, a boat and motor. A small laboratory was located in the Department of Civil Engineering at the University of Alberta. Bouthillier was on part-time staff at the University and spent the summers and half-time in winters working for the Department of Health on the stream pollution surveys.

The initial surveys covered all of Alberta, but the main points of concern were Edmonton and the North Saskatchewan River, Calgary and the Bow River, Lethbridge and the Oldman River.

Aside from assessing the physical facilities for waste treatment most of the testing consisted of the following:

1. dissolved oxygen levels in streams;
2. biochemical oxygen demand in streams and of sewage effluents;
3. bacterial (coliform counts) of river samples;
4. other tests - suspended solids, oils & grease, and phenolics; and
5. in some cases, odour numbers tests.

Keeping in mind the stage at which pollution control techniques had developed and the "one man" sampling and analysis situation, this start on pollution assessment was commendable. By the standards of the 1980's, it may be termed rudimentary. The measurement of these very basic parameters did, however, result in pollution control orders being issued to Edmonton and Calgary by the Provincial Board of Health in the early 1950's.

During the 1950's, the pollution control program expanded in staff and facilities. The laboratory remained in the Department of Civil Engineering at the U of A until about 1960, at which time nine provincial staff chemists and technicians were employed in the laboratory and in obtaining samples. The laboratory moved to the Alberta office building and subsequently was relocated to a site on Chem-cel property where a suitable building was leased. The laboratories are now located in Vegreville at the Alberta Environmental Centre.

THE NORTH SASKATCHEWAN RIVER

The first report on the North Saskatchewan River was written in 1951. Much of the river sampling was done at Fort Saskatchewan by boat

and, later, by lowering sample buckets from the bridge. Considerable effort was made to ascertain where the best sampling point (highest pollution) was with respect to the river cross-section.

Coliform counts varied from 20,000 to 160,000 per 100 ml of river water. Mid-stream samples appeared to be representative of total river quality. Under the "remarks" columm of the 1951 report (Table 1) were items such as:

a) visible floating and suspended solids (winter samples); and

b) large amounts of white feathery suspended material.*

Often, there were also bits of garbage and visible grease present. The author on one boat trip (Edmonton to Fort Saskatchewan) noted a car body "bouncing" its way downstream.

The key measurable parameter was dissolved oxygen. While summer values were near the normal values of 10 mg/L, the winter values were as low as 4.5 mg/L at Fort Saskatchewan. Samples from further downstream were not taken at that time; later sampling showed zero dissolved oxygen at Lloydminster.

The low winter values were caused by three factors:

1. The high biochemical oxygen demand (B.O.D.) of the waste flowing into the river. This was basically sewage from the City of Edmonton. The B.O.D. was measured and estimated at about 160,000 lbs/day (72,640 kg/d).

   (B.O.D. is the use of oxygen in the oxidation of organic matter by bacterial action. The process uses approximately one kg of oxygen for each kg of organic matter oxidized.)

* The author is uncertain at this time whether these were chicken feathers (from poultry processing) or toilet paper.

TABLE I

NORTH SASKATCHEWAN RIVER AT FORT SASKATCHEWAN

1950 Date	Time	pH	Temp. °C.	MPN B Coli per 100 ml North Bank	Mid Btream	South Bank
July 18	3 p.m.	7.5	16	22,300	4,100	2,050
July 20	3 p.m.	7.5	16	40,000	18,000	7,000
July 25	3 p.m.					
July 27	2 p.m.	7.5	18	35,000	35,000	35,000
July 27	4 p.m.	7.5	18	24,000	24,000	4,500
July 31	10 a.m.	7.5	17	54,000	54,000	17,000
July 31	12 noon	7.5	18	17,000	7,900	24,000
July 31	2 p.m.	7.6	18	17,000	4,500	7,900
Aug. 3	3 p.m.	8.2	18.3	35,000	0	54,000
Aug. 9	2:30 pm	7.5	17	92,000	17,000	160,000
Aug. 9	4 p.m.	7.5	17	35,000	24,000	17,000
Aug. 23	10 A.M.	7.5	17	35,000	35,000	92,000
Sept. 7	2 p.m.	7.5	15.5	20,000	20,000	20,000
Sept. 13	4 a.m.				92,000 92,000	
	6 a.m.				160,000 160,000	
	8 a.m.	7.5	14.5		92,000 160,000	
	10 a.m.				92,000 92,000	
	12 noon				92,000 160,000	
	2 p.m.				92,000 54,000	
	4 p.m.				17,000 13,000	
	6 p.m.				13,000 7,900	
	8 p.m.				6,900 28,000	
	10 p.m.				4,500 11,000	
	12 p.m.				54,000 54,000	
Oct 26	10 a.m.	7.7	2½	92,000	160,000	54,000 Visible floating and susp. solids.

TABLE I [CONT.]

NORTH SASKATCHEWAN RIVER AT FORT SASKATCHEWAN

1950 Date	Time	pH	Temp. °C.	MPN B COLI per 100 ml. North Bank	Mid Stream	South Bank	Remarks
Nov 2	1:00 pm	7.8	1		20,000	20,000	Visible floating and susp. solids & floating ice.
Dec 7	10:30 am	7.6	0	35,000	11,000		Solid Ice cover (6") Visible floating and susp. solids. Depth of river at sampling pts NB 2', MS 5'
	1:00 pm	7.6	0	54,000	17,000		
	3:00 pm	7.6	0	11,000	92,000		
Dec.14	10:30 am			22,000	160,000 +		Visible floating and susp. solids.
	1:00 pm			54,000	92,000		"
	3:30 pm			22,000	160,000 +		"
	6:00 pm			160,000	160,000		"
Jan 9	10:30 am	7.5	0	11,000	17,000		"
	5:30 pm	7.5	0		6,900		"
							18" ice at mid strea
					92,000		
Feb 14	3:00 pm	7.2			92,000		Large amount of white feathery susp. material.
Feb 21	10 am	7.7	0		54,000		
	11:30 am	7.5			92,000		
Mar.13	2:30 pm	7.4	0				
Mar 21	11:15 am	7.3			92,000		
	2:25 pm				35,000		
	4:10 pm			7,900			
	4:20 pm				17,000		
	8:30 pm			24,000	24,000		
	10:00pm			7,900	4,500		
Mar 22	12:01 am				4,500		
	2:15 am				7,900		
	4:00 am			17,000	11,000		

2. The lack of re-aeration of the river because of ice cover during winter months.

3. The low winter flows. The minimum monthly average daily flow on a once in ten year probability was 600 cubic feet per second (17 m^3/s).

The aforementioned conditions persisted until about 1960. By 1960, the loading on the river had been reduced to 60,000 lbs/day as compared to 160,000 lbs/day in the early 1950's. This reduction was the result of the installation of secondary sewage treatment by the City of Edmonton. Packing plant wastes were routed to lagoons in Clover Bar, thus reducing treatment plant costs. The packing plant wastes on the north side of the city represented approximately ten percent of the total sewage flow and twenty percent of the B.O.D. load. In addition, the packing plant wastes were high in fats.

In the 1950's, the Provincial Board of Health issued orders to the City of Edmonton and to all industries which had separate outfall sewers. The orders specified waste treatment requirements.

An estimate of the available dissolved oxygen in the North Saskatchewan River was made. On the basis of leaving a residual of 4 or 5 mg/L minimum at the Alberta-Saskatchewan border and on the basis of minimum low winter flows, estimates of permissible loadings were made. This total "allowable" was allotted as follows:

Total usable oxygen	40,000 lbs/d	18,160 kg/d
Allotments:		
City of Edmonton	20,000 lbs/d	9,080 kg/d
Industry (total)	10,000 lbs/d	4,540 kg/d
Spare Capacity	10,000 lbs/d	4,540 kg/d

The City of Edmonton allotment was based on the lowest B.O.D. which the secondary treatment of sewage could reasonably be expected to produce. The industrial quota was allotted on the basis of need, computed in proportion to production (e.g. oil refineries) and also on the basis of what good waste treatment could produce (best practical technology).

The aforementioned allotments were not computed merely to fill the maximum possible loading. Room was left for future expansion, and basic treatment of wastes was required. In some cases, lagooning was sufficient, in others expensive treatment and/or process changes were required.

The pollution of the river by phenols best illustrates the process. Prior to 1952 or thereabouts, the oil refinery effluents were passed through separators (settling tanks), which removed gross oil and sludge. The phenol content of the wastes was of the order of 100 kg per day. After controls were instituted, the allowable phenols were 10 kg/day.

This low allowable loading required process and piping changes to isolate phenolic wastes from other waste streams. The phenols were incinerated, shipped to Calgary for incineration or disposed of in deep wells.

As other industries were built, limits were set on their effluents. Among the pollutants controlled were:

- biochemical oxygen demand (BOD);
- phenols;
- chromates;
- oils and grease;
- odour number; and
- total flow of waste.

In the initial years of the application of allotments, there was a "winter" and summer allotment (the capacity of the river to assimilate wastes being much less in winter-low flows and ice-cover). This permitted the use of lagoons, which retained wastes over the winter period. At specified rates and times, the waste was drained into the river. The best example (still in use in 1983) is the over the winter lagooning of packing plant wastes in the Clover Bar lagoons operated by the City of Edmonton. (These lagoons are soon to be phased out)

In the 1950's, a major pollution problem arose when Chemcell (then Celanese of Canada) started production. This plant used natural gas as a raw material to produce synthetic fibre. There were also a number of other products or by-products of this process. The plant was the second of its kind in the world. Pollution control staff at that time were not aware of the potential problem. No prior experience or cases were available for study. The problem was one of "odor" in the effluent.

Effluent odour numbers were of the order of 100,000. That is to say, one part of the waste stream, diluted 100,000 times in clean odour free water, still had a detectable odour. This odor translates to taste in water. The recipients of the taste and odor problem was, in the main, the City of North Battleford.

The taste and odor were present in the drinking water, the source of which was the North Saskatchewan River.

It is difficult to portray the feelings of the people of North Battleford. The taste and odor permeated their lives. It was in the potatoes and the stew, the coffee, the tea and in their bath and shower water. Citizen groups were formed. The North Battleford City Council was confronted by an irate citizenry. Tomatoes were thrown at public meetings.

What was done about the problem?

In the first stages, thorough surveys were made of the concentration of "odors" in plant wastes and in the river. The source was traced to the primary oxidation unit at Chemcell. Operations had begun in August 1953. Since the river travel time to North Battleford was about four weeks, the taste and odor appeared in the water supply at North Battleford in December 1953. It was toward the end of January before surveys and reports of the specifics of the problem were finished. Samples of the waste streams and of concentrations of pollutants in the river water (collected in activated carbon filters) were sent to the Federal Government Laboratories in Ottawa for analysis. The Robert A. Taft Sanitary Engineering Center was also contacted regarding analyses for specific compounds in the waste. An analysis of specific constituents was finally made by Atlantic Refining Company in Philadelphia, it being at the time, the only laboratory with suitable analytical equipment (mass spectrophotometer).

Meanwhile the taste and odor was still in the "soup" in North Battleford.

The Alberta Government moved slowly on the problem. One reason was that the Celanese Plant was a first in industrial production in Alberta. It had been heralded as the beginning of a new era. Several hundred people were employed at the plant. The one option - closing the plant - was not a very desirable one from the Alberta point of view. A second reason was that it was the end of January before surveys were completed. If the plant were closed, the problem would still exist in North Battleford for another four weeks or more. The third reason (excuse?) was that the taste and odor problem was complicated by the

presence of other wastes. There was little doubt, however, of the real source of the problem.

Relief came with spring when the river ice melted and river flows increased. By the next winter, the primary oxidation unit drains at the Celanese plant were isolated from other plant drains. Lagoons were installed to hold some wastes over the winter. Some of the more odourous wastes were pumped down a deep well. The pollution control division of the Department of Health took daily samples of effluent streams to check odor numbers. The taste and odour did not recur in North Battleford.

A second major factor in the 1950's was the construction of the Brazeau Dam on the North Saskatchewan River above Edmonton. The provincial government was instrumental in hastening the construction of this dam and reservoir. The dam provides head and storage for the production of hydro power by Calgary Power. The incentive provided by the government was critized as aid to a private power company. However, the government insisted that, as a condition of construction, winter flows in the North Saskatchewan be held above a minimum of 57 m^3/s (2000 cfs). Since the winter period coincides with peak power requirements the arrangement has worked well. It may be noted that the winter flows in the Bow River had always been kept at about 50 m^3/s because of Calgary Power installations on those head waters.

In 1956, because of the presence of odours and the lack of dissolved oxygen in the North Saskatchewan River, a river aeration project was instituted. A 600 cubic ft. per minute compressor was used to inject air into the river. The air was released through orifices in a pipe which was laid on the bottom of the river. The effect of this

effort was minimal, the dissolved oxygen content was increased by only 0.25 mg/L.

A report on the February 1955 project showed dissolved oxygen values in the river of 1.75 mg/L at Fort Saskatchewan and petroleum and sewage odours were present in the river water. Dissolved oxygen values at Redwater were as low as 0.2 mg/L. At Waskatenau, dissolved oxygen values of 0.1 mg/L were recorded, and at points further downstream the dissolved oxygen level was often zero (septic conditions). River flows at this time were approximately 1000 c.f.s. (28.3 m^3/s).

Because of the need to monitor the river, a permanent continuous automatic sampling station was installed to sample the river water at Vinca. Continuous analysis is possible only for limited parameters. Nonetheless this station, which is still in use, serves very well to detect industrial spills or any large deviations from normal. Parameters are automatically recorded and transmitted directly to Edmonton. The station requires weekly maintenance.

One other major problem should be mentioned - mercury. In the 1970's mercury was identified as being a critical pollutant. While concentrations in water might be relatively low, it accumulated in the food chain and affected fish, animals, birds and man. Fish in the North Saskatchewan were analysed. The mercury content was above the 0.5 ppm limit set by Federal standards. While there was no large source of mercury bearing wastes in Alberta, a concerted effort was made to reduce even the smaller sources. Mercury in the fish still persists, but the mercury levels in the river water are at an acceptable low level.

Fish appear to be more abundant in the 1980's than they were in the 1950's and 1960's, and winter levels of dissolved oxygen are sufficient to maintain a healthy aquatic environment.

DEPARTMENT OF THE ENVIRONMENT OBJECTIVES

In 1967, a set of Water Quality Criteria was drafted. The original draft is shown (pages 15, 16 and 17). It illustrates the wide range of objectives and the fact that, even at that time, a total impact approach was used.

GARBAGE AND THE RIVER

The City of Edmonton had for many years placed fill along the river bank to combat erosion. The fill consisted of waste material such as scrap metal, concrete, asphalt, fill dirt, etc. While some care was taken to exclude organic material from this fill, the result was nonetheless objectionable. Some of the fill was washed downstream, and seepage would contain iron salts. The photographs on page 18 illustrate the situation, which was cleaned up in the 1950's.

The present landfill located in Clover Bar has been carefully designed so that no garbage or seepage flows into the river. Water, which accumulates in the landfill, is pumped out and treated.
New landfill sites for garbage disposal are carefully chosen to minimize environmental problems. They are subject to permits and licensing by the Department of Health and Social Services, and the Department of Environment provides technical input to the approval process.

DRAFT - May 29, 1967

WATER QUALITY CRITERIA
NORTH SASKATCHEWAN RIVER
AND THE SASKATCHEWAN RIVER

* * * * * *

The 'Criteria' outlined below are intended as a guide for the control of the quality of waste waters released to the rivers in recognition of the uses made of the rivers.

The current uses of the North Saskatchewan River in Alberta and Saskatchewan and the subsequent Saskatchewan River in Saskatchewan and Manitoba are as follows:

(a) Source of municipal domestic water supply.

(b) Irrigation - limited to minor market garden use.

(c) Industrial cooling and process water requirements.

(d) Salt (NaCl) solution - mining requirements (Alberta only)

(e) Fish and wildlife propagation - sports fishing, (commercial fishing - Manitoba only)

(f) Recreation - limited use except for boating, fishing, hiking, picnic areas and camping.

(g) Hydro-electric power generation.

(h) Waste water disposal - industrial and municipal.

'Water Quality Requirements' are those necessary to allow the beneficial uses to be achieved after the water from the rivers is treated in a manner equal to that normally required to remove naturally occurring materials detrimental to that use. It is recognized that within each province there will be certain areas of the rivers immediately downstream of waste water release points which may have water quality inferior to that outlined below and that use of water in these areas may be curtailed. It is also appreciated that the uses made of the river will change in the future and therefore there will be a need to review these Water Quality Criteria periodically.

The 'Water Quality Criteria' and/or an appropriate waste water quality for control purposes are as follows:

1. Bacteriological:

Coliform bacteria criteria

(a) Domestic water supply	- geometric mean MPN value not more 2,000 coliforms per 100 ml. over any 30-day period; and not more than 20% of the samples in the 30-day period to exceed an MPN of 5,000/100 ml.
(b) Market gardening	- same as (a) above
(c) Recreation	- same as (a) above

2. Dissolved Oxygen:	- 5 mg/1, minimum mean value in any 30-day period. Minimum single reading - 3 mg/l.
3. Odor: Threshold Odor Number (cold)	- 4 to 8 - mean value in any 30-day period. - 8 to 16 - maximum reading (indicates questionable water quality)
4. Phenolics:	- 3 ppb. - maximum mean value, 30-day period. Not more than 20% of the samples to exceed 5 ppb. in any 30-day period.
5. Oil and Grease	- no iridescent sheen or visible floating material on water surface. (Basic effluent requirement - 25 mg./l. of non-volatile oil).
6. Suspended solids	- no visible suspended solids in the receiving water after dilution. (Basic effluent requirement - 100 ppm. of total suspended solids, however a normal (2 hour) settling of all waste water is required. Suspended solids removed in water treatment processes excepted).
7. Heavy metals and other deleterious substances	- less than the concentration generally accepted (e.g. current U.S.P.H.S. published standards) for domestic water supplies
8. Carbon - chloroform extract	- less than 0.2 mg. per litre

9.	pH:	- 6.5 to 8.5
10.	Nutrient materials, i.e. phosphate and nitrogen compounds	- to be monitored and evaluated against water use problems and the occurrence of algae and other biological growths.

In the application of these 'Water Quality Criteria', the quality of waste waters and the rate of release shall be controlled so that the river water quality is maintained within the criteria levels after the calculated dilution in the river. Where downstream users are affected by the waste waters not completely diluted in the river flow, special outlet structures to achieve the effective dilution within the available river length may be required. Naturally occurring circumstances are not taken into account in these 'Criteria' and due consideration must be given where applicable, e.g. spring run-off effect on color, odor, etc.

H. L. Hogge

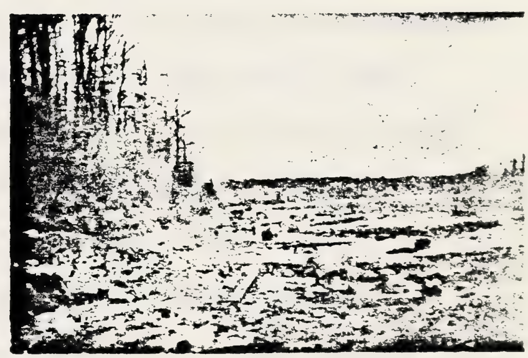
29th May, 1967

Environmental Health Services Division,
Department of Health,
Government of Alberta.

Looking west from east end of garbage dump

Garbage dump viewed from across river

View of Highlands outfall



Area upstream from highlands outfall.

Photos taken May 1951 showing condition of river bank below garbage disposal area.

THE PROBLEM OF COMBINED SEWERS

The original sewer system in Edmonton handled both sewage and surface runoff. Combined systems were commonly used throughout the world; they were a natural development from the times when it became legal to put sewage into storm drains (England in the 1800's). Combined sewers present a number of problems, one of which is that when rainfall occurs much of the combined flow must be bypassed to the river. The storm flow is many times larger than the dry weather flow of sewage.

Beginning in the 1950's, the City of Edmonton installed only separate sewers, (i.e. storm water flow in storm drains and sewage flows in sanitary sewers). This separation of surface runoff from sewage permits locating storm drain outfalls at several points along the river. Storm water flows occur in spring and summer when the North Saskatchewan River is open and flows in the river are high. To the present (1983), treatment of storm drainage has not been required. While storm drainage does contain pollutants, the drainage is of short duration and pollution is assimilated by high dilution. Very few cities provide treatment of storm drainage: it is extremely costly and, aside from aesthetics, in most cases produces little real improvement in river water quality.

OTHER SOURCES OF WASTES

Pages 21 and 22 are excerpts from the 1971-72 annual report of the Pollution Control Division of the Department of the Environment. The excerpts provide the types of tests conducted, the total loading and the many sources of effluent flowing into the river, and the type of waste treatment provided at the time. The lagoon-type treatment provided for many of the wastes is, with adequate detention, the equivalent of

secondary waste treatment: it removes most of the B.O.D. and bacteria. In order to provide further protection to the source of Edmonton's drinking water, the Town of Devon has also been chlorinating their treated sewage prior to disposal in the North Saskatchewan River .

listing of the waste water dischargers and users of river water in the North Saskatchewan River basin is tabulated in the Appendix. The total loadings of various pollutants for each survey are also tabulated in the Appendix.

The following lists the minimum, mean, and maximum loadings of 8 constituents during four winter surveys:

CONSTITUENT	LOADINGS (lbs/day)		
	Min.	Mean	Max.
Biochemical Oxygen Demand (5-day, 20°C)	25,500	28,850	34,200
Chemical Oxygen Demand	46,400	81,050	134,500
Oil and Grease	2,790	3,300	4,150
Phenolics	11	19	33
Total Phosphorous	3,190	7,920	11,300
Ammonia Nitrogen	12,500	13,500	16,100
Nitrate Nitrogen	200	670	1,360
Hexavalent Chromium	5	20	39

DISSOLVED OXYGEN

Biological degradation of organic matter by bacteria results in an oxygen depression in our rivers, particularly during the winter when ice cover prevents re-aeration. Testing for dissolved oxygen at various locations in the river provides a means for assessing this rate of biodegradation and provides an index for the performance of the river.

Dissolved Oxygen remained relatively high from the Brazeau River sampling location to Waskatenau Bridge. Minimum value in this portion of the river was 9.2 mg/l at Waskatenau Bridge on the survey of February 2, 1972. Dissolved Oxygen was further depressed at downstream locations. The lowest value observed during the winter was 6.7 mg/l at Lloydminster Ferry. Mean values during ice cover were 8.3 mg/l at Duvernay Bridge,

EXCERPT FROM 1972 - 72 REPORT

NORTH SASKATCHEWAN EFFLUENT DISCHARGERS

Source	Type of Discharge and Treatment
Town of Rocky Mountain House	Domestic Sewage (L)
Town of Drayton Valley	Domestic Sewage (L)
Town of Devon	Domestic Sewage (ST)
Imperial Oil - Devon	Industrial (L)
City of Edmonton	Domestic Sewage (ST in Winter)
Canadian Industries Ltd.	Industrial Waste (WELL)
Building Products Ltd.	Industrial Waste (AERATED LAGOONS)
Imperial Oil Ltd.	Industrial Waste (AERATED LAGOONS)
Texaco Canada Limited	Industrial Waste (A.P.I., WELL, L)
Union Carbide Canada Ltd.	Industrial Waste (L)
Turbo Oil Limited	Industrial Waste (L)
Gulf Oil Canada Limited	Industrial Waste (A.P.I., L)
Celanese Canada Limited	Industrial Waste (WELL, L)
Uniroyal	Industrial Waste (L - Summer Discharge)
Alberta Hospital - Oliver City of Edmonton Packing Plants Sherwood Park	Waste Storage & Disposal during Summer Months (L) to City Lagoons
Town of Fort Saskatchewan	Domestic Sewage (L)
Sherritt Gordon Mines Ltd.	Industrial Waste (L)
Dow Chemical Limited	Industrial Waste (L, WELL)
Redwater Imperial Fertilizer	Industrial Waste (L)
Redwater Imperial Oil Gas Plant	Industrial Waste (L)
Celanese Canada Ltd. - Duvernay	Industrial Waste (NT)
Elk Point	Domestic Sewage (L)
Canadian Salt Co. Ltd.	Industrial Waste (NT)

LEGEND:

L - Lagoon

ST - Secondary Treatment

NT - No Treatment

API - A.P.I. Separator

EDMONTON WATER SUPPLY

There have been a number of times when "taste and odour" were present in the City of Edmonton drinking water.

Normal treatment processes do not remove "taste and odour". Treatment processes for taste and odour removal work only moderately well. One source of the taste is the spring runoff of waters which have been stagnating over the winter period. This problem occurs each year.

Other cases have been the result of oil or chemical spills into the North Saskatchewan River. Because there are some storm drain outlets above the intake of the Rossdale water treatment plant, the problem is aggrevated somewhat. Some spills, however, may go directly into the river. The incident of the wild oil well at Leduc was one such incident. The taste and odour problem is not however the result of some continuous waste streams flowing into the river.

Figure 1 illustrates to a great extent the progress which has been made in river water quality improvement over the years. While it is true that dissolved oxygen content is not the only pollution parameter, it reflects better than any other the trend of pollution control.

What is the situation in the 1980's?

To predict with some precision the change in the degree of pollution of the North Saskatchewan River would be a formidable task. It would involve a review of the hundreds of thousands of analyses which have been made and an interpretation of their relative weight. One parameter which reflects the general reduction in loading on the river is the dissolved oxygen content. Figure 1 illustrates rather well the progress made in controlling the organic loading on the river. It reflects also the benefits which have been obtained by the increase in the winter flows.

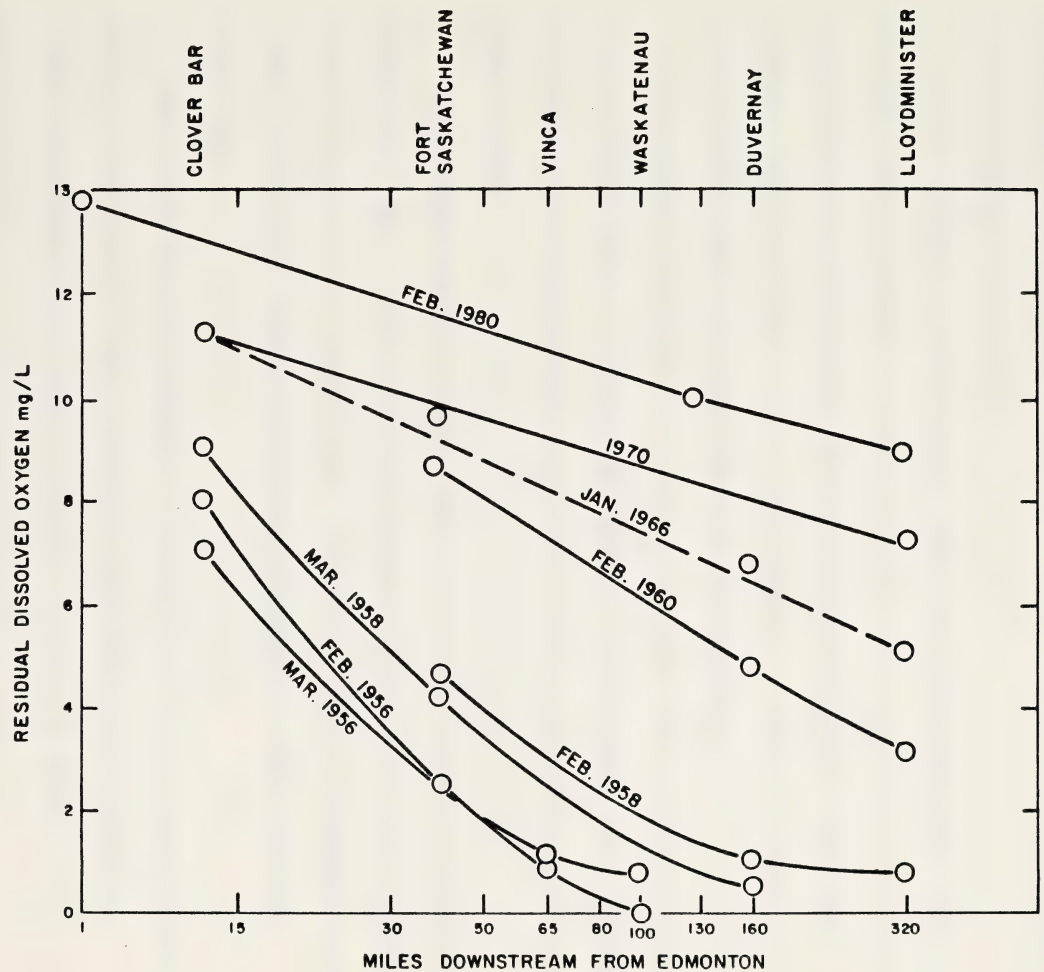


FIGURE I. RESIDUAL DISSOLVED OXYGEN
NORTH SASKATCHEWAN RIVER

The control program has been successful in attaining and maintaining a dissolved oxygen level of about 5 mg/L at the Alberta-Saskatchewan border. This objective has been reached only by diligent monitoring, redefining effluent limits and the general cooperation of industry and municipalities.

Figure 1 does not show clearly that the dissolved oxygen level of the river above Edmonton is often much below the theoretical saturation value, which is approximately 14 milligrams per litre of dissolved oxygen. This low oxygen content is a feature of natural streams in winter periods when ice cover precludes re-aeration.

The Alberta Environment continues to control the discharge of waste flows and pollutants. A system of "Permits to Construct" and "Licences to Operate" was instituted in the early 1970's. Waste quotas are always under review.

The Bighorn and the Brazeau dams and reservoir aid in raising the low winter flows. Dissolved oxygen levels at the Alberta-Saskatchewan border are held at or above 5 mg/L. Fish life is fairly abundant in the river. The City of Edmonton continues to upgrade sewage treatment facilities.

Many "new" trace pollutants, of which P.C.B. is an example, have been detected and are being controlled, and there is an attempt to reduce phosphates and nitrogen in wastes in order to retard eutrophication.

Is the North Saskatchewan river polluted? Is it polluted below Edmonton? Is it polluted between Edmonton and Devon, or between Deveon and Rocky Mountain House?

The purist will answer "yes" to all of the foregoing questions. Certainly below Edmonton the river is heavily loaded. The river quality

has improved greatly, however, since the 1950's. It would be almost impossible physically and economically to keep all wastes out of the river.

In order to store data in a retrievable manner, the Alberta Environment has for some years stored river water quality data in computer banks. Use of the computer enables manipulation of data to obtain averages, maximum and minimum values. The data are filed with NAQUADAT, a National Quality Data bank. One output from NAQUADAT is provided in Appendix "A". It illustrates the complexity of water pollution monitoring of the 1980's -- a contrast to the brief reports of 1951 (Table 1; Page 6).

A number of tables and figures are shown in Appendix "B". Some are copies of originals, most are taken from Department of Environment yearly reports. They illustrate the types of studies and controls as well as the progress of pollution control. Items listed in Appendix "B" are:

B-1 1969-70 North Saskatchewan River Pollution Survey showing location and frequency of sampling.

B-2 1968-69 Pollutant levels at Lloydminster Ferry (north of Lloydminster). Note min. D.O. of 5.5 mg/L, Feb. 26, 1969.

B-3 1969-70 Pollutant levels at Lloydminster Ferry (north of Lloydminster). Min. O.O = 6.4 mg/L.

B-4 Loadings to North Saskatchewan River 1971-1972.

B-5 Winter river flow-comparison of 1955-56 to 1974-75.

B-6 Pollutant profile of North Saskatchewan River February 26, 1969 Edmonton and Lloydminster.

B-7 Pollutant profile of NSR March 17, 1970 Edmonton to Lloydminster.

B-8 Pollutant profile of NSR March 1, 1972 Rocky Mountain House to Lloydminster.

Continuing vigilance, testing, control and improvement in waste treatment will be necessary to maintain and possibly further improve water quality in the North Saskatchewan River.

APPENDIX "A"

NAQUADAT Printout of Data

North Saskatchewan River

1983

NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05DF0008 LAT. 53D 22M 9S LONG. 113D 45M 6S PR 4 UTM 12 317000E 5916600N FOR JAN 12, 1981 TO DEC 07, 1981
NORTH SASKATCHEWAN RIVER AT DEVON, ALBERTA

	10151L ALKALINITY PHENOL PHTHALEIN	10101L ALKALINITY TOTAL	20103L CALCIUM DISSOLVED	12102L MAGNESIUM DISSOLVED	12101L MAGNESIUM DISSOLVED (CALCD.)	19103L POTASSIUM DISSOLVED	11103L SODIUM DISSOLVED	17206L CHLORIDE DISSOLVED
SUBM	CACO3	CACO3	CA	MG	MG	K	NA	CL
ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS) 0479	12(0)	12(0)	12(0)	12(0)		12(0)	12(0)	12(0)
LOW	.0	113.0	40.4	12.0		.5	2.6	.5
HIGH	2.	153.0	52.30	14.7		1.8	5.4	1.5
AVERAGE	.2	128.1	44.96	13.3		.78	3.67	.7
STD.DEV.	.6	10.5	3.32	1.0		.35	.94	.3
PERCNT:10TH	.0	118.	41.80	12.3		.6	2.7	.5
25TH	.0	123.0	42.35	12.4		.60	2.90	.6
MEDIAN 50TH	.0	126.5	44.90	13.0		.65	3.45	.6
75TH	.0	131.0	47.00	14.4		.85	4.40	.7
90TH	.0	140.0	48.10	14.5		.9	5.0	.7
SECONDARY CODE								

	09105L FLUORIDE DISSOLVED	14102L SILICA REACTIVE	16306L SULPHATE DISSOLVED	02061S TEMPERATURE OF WATER	10301L PH	10301S PH	02041L SPECIFIC CONDUCT.	02041S SPECIFIC CONDUCT.
SUBM	F	SIO2	SO4					
ID	MG/L	MG/L	MG/L	DEG.C.	PH UNITS	PH UNITS	US/CM	US/CM
SAMPLES(FLAGS) 0479	12(0)	12(0)	12(0)	12(0)	12(0)		12(0)	10(0)
LOW	.09	3.0	27.	.0	7.9		303.	226.
HIGH	.16	6.00	43.0	19.0	8.4		422.	351.
AVERAGE	.13	4.30	33.7	9.47			336.	295.
STD.DEV.	.02	.90	4.7	7.99			33.	38.
PERCNT:10TH	.10	3.2	28.	.5	7.9		308.	244.
25TH	.12	3.65	30.0	.75	8.0		312.	280.
MEDIAN 50TH	.13	4.30	34.0	11.00	8.2		329.	289.
75TH	.15	4.85	36.5	16.85	8.3		353.	328.
90TH	.16	5.4	38.0	18.0	8.4		356.	348.
SECONDARY CODE		05L		61F 61L				41F

	10602L HARDNESS TOTAL (CALCD.)	06201L BICARBONT. (CALCD.)	06301L CARBONATE (CALCD.)	02073L TURBIDITY	02073S TURBIDITY	02011L COLOUR APPARENT	08101P OXYGEN DISSOLVED DO	07110L NITROGEN DISSOLVED NO3 & NO2
SUBM	CACO3	HCO3	CO3				O2	N
ID	MG/L	MG/L	MG/L	JTU	JTU	REL. UNITS	MG/L	MG/L
SAMPLES(FLAGS) 0479	12(0)	12(0)	12(0)	12(0)	9(0)	3(0)	6(0)	
LOW	150.3	138.	0.	2.1	2.5	5.	9.0	
HIGH	191.1	187.	2.	52.	104.	20.	13.1	
AVERAGE	167.0	156.	0.	9.3	19.7	10.	11.5	
STD.DEV.	11.7	13.	1.	13.9	32.7	9.	1.7	
PERCNT:10TH	155.0	144.	0.	2.2				
25TH	157.0	150.	0.	2.8	3.8		9.8	
MEDIAN 50TH	167.3	154.	0.	4.2	4.0	5.	12.0	
75TH	173.3	157.	0.	9.8	22.0		13.1	
90TH	179.1	171.	0.	12.0				
SECONDARY CODE					73F			

NAQUADAT SUMMARY REPORT AUG 22, 1983
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NORTH SASKATCHEWAN RIVER AT DEVON, ALBERTA

		07651L	07902L	07110L	07105L	07001L	07506L	15406L	15103L
		NITROGEN	NITROGEN	NITROGEN	NITROGEN	NITROGEN	NITROGEN	PHOSPHOROUS	PHOSPHORUS
		DISSOLVED	PARTICUL.	DISSOLVED	DISSOLVED	TOTAL	TOTAL	TOTAL	DISSOLVED
				NO3 & NO2	NO3 & NO2	KJELDAHL	AMMONIA	PHOSPHATE	
	SUBM	N	N	N	N	N	N	P	P
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0479	12(0)	12(4)	12(4)			6(6)	12(1)	12(5)
LOW		.07	L.010	L.01			L.10	L.00	L.003
HIGH		.31	.24	.07			L.1	.08	.021
AVERAGE		.13	.061*	.03*				.02*	.006*
STD.DEV.		.07	.068*	.03*				.02*	.005*
PERCNT:10TH		.07	L.01	L.01				.01	L.003
25TH		.07	L.010	L.01			L.10	.01	L.003
MEDIAN 50TH		.14	.040	.02			L.100	.01	.003
75TH		.15	.070	.06			L.1	.02	.007
90TH		.20	.14	.07				.03	.009
SECONDARY CODE				10F					03F

		15256L	15413L	06902L	06151L	06101L	06051L	06001L	10401L
		PHOSPHORUS	PHOSPHORUS	CARBON	CARBON	CARBON	CARBON	CARBON	RESIDUE
		DISSOLVED	TOTAL	ORGANIC	DISSOLVED	DISSOLVED	TOTAL	TOTAL	NONFILTR.
		ORTHO PO4	PHOSPHATE	PARTICULATE	INORGANIC	ORGANIC	INORGANIC	ORGANIC	
	SUBM	P	P	C	C	C	C	C	
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0479		12(1)	11(0)		11(0)			12(0)
LOW			L.003	.14		1.7			3.
HIGH			.084	2.4		5.1			97.
AVERAGE			.019*	.579		2.8			18.
STD.DEV.			.022*	.633		1.3			26.
PERCNT:10TH			.007	.150		1.9			3.
25TH			.008	.230		2.0			4.
MEDIAN 50TH			.009	.450		2.1			9.
75TH			.021	.64		4.5			21.
90TH			.032	.71		5.0			23.
SECONDARY CODE			06L			04F 04L			

		10501L	36002L	36012L	36102L	06711L	08201L	06510P	06521L
		RESIDUE	COLIFORMS	COLIFORMS	STREP.	CHLORO -	OXYGEN	AROMATIC	OIL AND
		FIXED	TOTAL	FECAL	FECAL	PHYLL A	BIOCHEM.	HYDROC.	GREASE
		NONFILTR.					DEMAND-BOD		
	SUBM		MF	MF	MF		O2		
	ID	MG/L	NO/100ML	NO/100ML	NO/100ML	MG/L	MG/L	UG/L	MG/L
SAMPLES(FLAGS)	0479		8(3)	10(3)	4(1)				
LOW			L1.	L1.	1.				
HIGH			120.	66.	G120.				
AVERAGE			23.*	12.*	42.*				
STD.DEV.			41.*	20.*	56.*				
PERCNT:10TH				L1.					
25TH			L2.	L2.	2.				
MEDIAN 50TH			5.	2.	24.				
75TH			24.	18.	83.				
90TH				43.					
SECONDARY CODE			02F	12F	02F				

* THESE STATISTICS INCLUDE VALUES FLAGGED WITH L,G OR Q

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STATION 00AL05DF0008 LAT. 53D 22M 9S LONG. 113D 45M 6S PR 4 UTM 12 317000E 5916600N FOR JAN 12, 1981 TO DEC 07, 1981
NORTH SASKATCHEWAN RIVER AT DEVON, ALBERTA

	SUBM	26304P IRON EXTRBLE.	26104L IRON DISSOLVED	56301P BARIUM EXTRBLE.	25104L MANGANESE DISSOLVED	25304P MANGANESE EXTRBLE.	48302P CADMIUM EXTRBLE.	27302P COBALT EXTRBLE.	27020P COBALT TOTAL RECOVERABLE
		FE	FE	BA	MN	MN	CD	CO	CO
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0479		12(10)		12(9)				4(2)
LOW			L.04		L.01				L.002
HIGH			.06		.02				.007
AVERAGE			.04*		.01*				.003*
STD.DEV.			.01*		.00*				.003*
PERCNT:10TH			L.04		L.01				
25TH			L.04		L.01				L.002
MEDIAN 50TH			L.04		L.01				.002*
75TH			L.04		.01*				.005
90TH			.05		.02				
SECONDARY CODE									

	SUBM	30020P ZINC TOTAL RECOVERABLE	30305P ZINC EXTRBLE.	23302P VANADIUM EXTRBLE.	23020P VANADIUM TOTAL RECOVERABLE	34102L SELENIUM DISSOLVED	56020P BARIUM TOTAL RECOVERABLE	80313P MERCURY EXTRACTABLE	80011P MERCURY TOTAL
		ZN	ZN	V	VA	SE	BA	HG	HG
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L
SAMPLES(FLAGS)	0479	3(0)			4(3)	12(11)	2(0)		10(8)
LOW		.001			L.001	L.0005	.06		L.02
HIGH		.003			.002	.0005	.06		.02
AVERAGE		.002			.001*	.0005*	.06		.02*
STD.DEV.		.001			.001*	.0000*	.00		.00*
PERCNT:10TH						L.0005			L.02
25TH					L.001	L.0005			L.02
MEDIAN 50TH		.003			L.001	L.0005	.06		L.02
75TH					.001*	L.0005			L.02
90TH						L.0005			.02
SECONDARY CODE						02F			

	SUBM	47301P SILVER EXTRBLE.	13305P ALUMINUM EXTRBLE.	04301P BERYLLIUM EXTRBLE.	24302P CHROMIUM EXTRBLE.	05105L BORON DISSOLVED	42301L MOLYBDENUM EXTRBLE.	06604P CYANIDE TOTAL	18130L ALDRIN
		AG	AL	BE	CR	B	MO	CN	
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
SAMPLES(FLAGS)	0479	2(2)				7(0)			4(4)
LOW		L.004				.03			L.001
HIGH		L.004				.05			L.001
AVERAGE						.04			
STD.DEV.						.01			
PERCNT:10TH									
25TH						.03			L.001
MEDIAN 50TH		L.004				.04			L.001
75TH						.05			L.001
90TH									
SECONDARY CODE									

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NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05DF0008 LAT. 53D 22M 9S LONG. 113D 45M 6S PR 4 UTM 12 317000E 5916600N FOR JAN 12, 1981 TO OCT 05, 1981
NORTH SASKATCHEWAN RIVER AT DEVON, ALBERTA

SUBM ID	18075L ALPHA-BHC	18060L ALPHA-CHLORDANE	18065L GAMMA-CHLORDANE	18005L O,P-DDT	18010L P,P-DDD	18020L P,P-DDE	18000L P,P-DDT	18150L DIELDRIN
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS) 0479	4(0)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)
LOW	.002	L.003	L.002	L.001	L.002	L.001	L.004	L.002
HIGH	.007	L.003	L.002	L.001	L.002	L.001	L.004	L.002
AVERAGE	.005							
STD.DEV.	.002							
PERCNT:10TH								
25TH	.004	L.003	L.002	L.001	L.002	L.001	L.004	L.002
MEDIAN 50TH	.006	L.003	L.002	L.001	L.002	L.001	L.004	L.002
75TH	.007	L.003	L.002	L.001	L.002	L.001	L.004	L.002
90TH								
SECONDARY CODE								

SUBM ID	18050L ALPHA-ENDO-SULFHAN	18055L BETA-ENDO-SULFHAN	18140L ENDRIN	18040L HEPTACHLOR	18045L HEPTACHLOR EPOXIDE	18070L GAMMA-BHC (LINDANE)	18030L P,P-METHOXY-CHLOR	18520P MCPA
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS) 0479	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	3(3)
LOW	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.200
HIGH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
AVERAGE								
STD.DEV.								
PERCNT:10TH								
25TH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	
MEDIAN 50TH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
75TH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	
90TH								
SECONDARY CODE								

SUBM ID	18555P 2,4-DP	18500P 2,4-D	18510P 2,4,5-T	18550P 2,4-DB	18125L MIREX TOTAL	18164L ARCCLORS TOTAL (PCB'S)	18161L AROCLOR 1248 (PCB'S)	18160L AROCLOR 1254 (PCB'S)
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS) 0479	3(3)	3(2)	3(3)	3(3)	4(4)	4(4)	1(1)	4(4)
LOW	L.004	L.004	L.002	L.009	L.001	L.002	L.002	L.002
HIGH	L.004	.01	L.002	L.009	L.001	L.002	L.002	L.002
AVERAGE		.006*						
STD.DEV.		.003*						
PERCNT:10TH								
25TH					L.001	L.002		L.002
MEDIAN 50TH	L.004	L.004	L.002	L.009	L.001	L.002		L.002
75TH					L.001	L.002		L.002
90TH								
SECONDARY CODE								

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NORTH SASKATCHEWAN RIVER AT DEVON, ALBERTA

	SUBM ID	18600L PICLORAM (TORDON) UG/L	18162L AROCLOR 1260 (PCB'S) UG/L	18190P GUTHION UG/L	18195P AZIN-PHOSETHYL UG/L	18205P IMIDAN UG/L	18215P DISULFOTON UG/L	18230P CRUFOMATE UG/L	18240P PARTHION UG/L
SAMPLES(FLAGS)	0479	1(1)	4(4)	4(4)	4(4)	4(4)	2(2)	4(4)	4(4)
LOW		L.20	L.005	L.5	L.20	L.20	L.020	L.20	L.02
HIGH		L.20	L.005	L.5	L.20	L.20	L.02	L.20	L.02
AVERAGE									
STD.DEV.									
PERCNT:10TH									
25TH			L.005	L.5	L.20	L.20		L.20	L.02
MEDIAN 50TH			L.005	L.5	L.20	L.20	L.020	L.20	L.02
75TH			L.005	L.5	L.20	L.20		L.20	L.02
90TH									
SECONDARY CODE		01P							

	SUBM ID	18245P PARATHION-METHYL UG/L	18250P MALATHION UG/L	18260P FENCHLORPHOS (RONNEL) UG/L	18270P DIAZIONON UG/L	18300P PHORATE UG/L	18310P ETHION UG/L	18320P CARBO-PHENOTHION UG/L	18540P SILVEX UG/L
SAMPLES(FLAGS)	0479	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	3(3)
LOW		L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
HIGH		L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
AVERAGE									
STD.DEV.									
PERCNT:10TH									
25TH		L.02	L.05	L.02	L.02	L.02	L.02	L.02	
MEDIAN 50TH		L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
75TH		L.02	L.05	L.02	L.02	L.02	L.02	L.02	
90TH									
SECONDARY CODE									

	SUBM ID	33104L ARSENIC DISSOLVED AS MG/L	29305P COPPER EXTRBLE. CU MG/L	29020P COPPER TOTAL RECOVERABLE CU MG/L	28302P NICKEL EXTRBLE. NI MG/L	28020P NICKEL TOTAL RECOVERABLE NI MG/L	48020P CADMIUM TOTAL RECOVERABLE CD MG/L	82302P LEAD EXTRBLE. PB MG/L	82020P LEAD TOTAL RECOVERABLE PB MG/L
SAMPLES(FLAGS)	0479			4(3)		3(1)	2(2)		2(2)
LOW				L.001		L.002	L.001		L.004
HIGH				.003		.005	L.001		L.004
AVERAGE				.001*		.003*			
STD.DEV.				.001*		.002*			
PERCNT:10TH									
25TH				L.001					
MEDIAN 50TH				L.001		.002	L.001		L.004
75TH				.002*					
90TH									
SECONDARY CODE									

* THESE STATISTICS INCLUDE VALUES FLAGGED WITH L,G OR Q

NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05DF0008 LAT. 53D 22M 9S LONG. 113D 45M 6S PR 4 UTM 12 317000E 5916600N FOR JAN 12, 1981 TO DEC 07, 1981
NORTH SASKATCHEWAN RIVER AT DEVON, ALBERTA

	SUBM ID	17811L HEXACHLORO-BENZENE	06535P PHENOLIC MATERIAL PHENOL	06717L CHLORO-PHYLL A	07904L NITROGEN PARTICULATE (CALCD.) N	18159L AROCLOR 1242 (PCB'S)	10122L TOTAL ALKALINITY	54502L CARBON FIXATION EPILITHON C	06720L CHLOROPHYLL -A- PHYTOPLANKTON
		UG/L	MG/L	MG/L	MG/L	UG/L	MEQ/L	MG/M2/HR	MG/M3
SAMPLES(FLAGS)	0479	4(4)	12(7)	12(6)		3(3)			
LOW		L.001	L.001	L.001		L.002			
HIGH		L.001	.002	.003		L.002			
AVERAGE			.001*	.0013*					
STD.DEV.			.000*	.0007*					
PERCNT:10TH			L.001	L.001					
25TH		L.001	L.001	L.0010					
MEDIAN 50TH		L.001	L.001	.0010*		L.002			
75TH		L.001	.001	.0015					
90TH			.002	.002					
SECONDARY CODE									

* THESE STATISTICS INCLUDE VALUES FLAGGED WITH L,G OR Q

NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05EC0005 LAT. 54D 0M 9S LONG. 112D 23M 54S PR 4 UTM 12 408400E 5984500N FOR JAN 13, 1981 TO DEC 08, 1981
NORTH SASKATCHEWAN RIVER AT PAKAN, ALBERTA

	SUBM ID	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	20103L CALCIUM DISSOLVED CA MG/L	12102L MAGNESIUM DISSOLVED MG MG/L	12101L MAGNESIUM DISSOLVED (CALCD.) MG MG/L	19103L POTASSIUM DISSOLVED K MG/L	11103L SODIUM DISSOLVED NA MG/L	17206L CHLORIDE DISSOLVED CL MG/L
SAMPLES(FLAGS)	0479	11(0)	12(0)	12(0)	12(0)		12(0)	12(0)	12(0)
LOW		.0	113.	40.5	11.5		.7	4.0	1.7
HIGH		3.3	384.0	122.00	58.0		5.0	27.0	14.0
AVERAGE		.3	151.3	51.37	16.9		1.50	8.07	3.5
STD.DEV.		1.0	73.7	22.39	13.0		1.33	6.30	3.4
PERCNT:10TH		.0	121.	40.80	11.7		.8	4.3	1.7
25TH		.0	127.0	43.20	12.3		.90	5.30	1.9
MEDIAN 50TH		.0	133.5	45.95	13.5		1.00	6.10	2.3
75TH		.0	136.0	47.15	14.0		1.10	7.10	3.2
90TH		.2	138.0	48.30	14.9		3.5	12.	5.2
SECONDARY CODE									

	SUBM ID	09105L FLUORIDE DISSOLVED F MG/L	14102L SILICA REACTIVE SIO2 MG/L	16306L SULPHATE DISSOLVED SO4 MG/L	02061S TEMPERATURE OF WATER DEG.C.	10301L PH PH UNITS	10301S PH PH UNITS	02041L SPECIFIC CONDUCT. US/CM	02041S SPECIFIC CONDUCT. US/CM
SAMPLES(FLAGS)	0479	12(0)	12(0)	12(0)	12(0)	12(0)		12(0)	10(0)
LOW		.12	1.2	28.	.0	7.8		309.	235.
HIGH		.34	16.00	178.0	19.5	8.7		1058.	985.
AVERAGE		.16	4.69	47.8	9.53			413.	376.
STD.DEV.		.06	3.79	41.3	8.07			205.	218.
PERCNT:10TH		.13	1.9	30.	.0	7.9		322.	244.
25TH		.13	2.70	31.5	.50	8.0		335.	295.
MEDIAN 50TH		.14	4.40	37.0	10.75	8.2		356.	317.
75TH		.17	4.60	42.0	16.95	8.4		385.	365.
90TH		.18	5.5	43.0	19.0	8.6		396.	680.
SECONDARY CODE			05L		61F 61L				41F

	SUBM ID	10602L HARDNESS TOTAL (CALCD.) CACO3 MG/L	06201L BICARBONT. (CALCD.) HCO3 MG/L	06301L CARBONATE (CALCD.) CO3 MG/L	02073L TURBIDITY JTU	02073S TURBIDITY JTU	02011L COLOUR APPARENT REL. UNITS	08101P OXYGEN DISSOLVED DO O2 MG/L	07110L NITROGEN DISSOLVED NO3 & NO2 N MG/L
SAMPLES(FLAGS)	0479	12(0)	11(0)	11(0)	12(0)	9(0)	3(0)	6(0)	
LOW		148.5	138.	0.	1.4	3.0	5.	8.4	
HIGH		543.4	468.	4.	76.	36.	20.	13.4	
AVERAGE		197.8	187.	0.	15.0	14.0	12.	11.2	
STD.DEV.		109.3	94.	1.	21.1	13.7	8.	2.0	
PERCNT:10TH		150.0	147.	0.	2.1				
25TH		160.6	157.	0.	2.9	4.0		8.9	
MEDIAN 50TH		169.2	162.	0.	7.0	6.0	10.	12.0	
75TH		176.6	165.	0.	17.5	28.		12.2	
90TH		180.0	167.	0.	30.0				
SECONDARY CODE						73F			

NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05EC0005 LAT. 54D 0M 9S LONG. 112D 23M 54S PR 4 UTM 12 408400E 5984500N FOR JAN 13, 1981 TO DEC 08, 1981
NORTH SASKATCHEWAN RIVER AT PAKAN, ALBERTA

	SUBM ID	07651L NITROGEN DISSOLVED N MG/L	07902L NITROGEN PARTICUL. N MG/L	07110L NITROGEN DISSOLVED NO3 & NO2 N MG/L	07105L NITROGEN DISSOLVED NO3 & NO2 N MG/L	07001L NITROGEN TOTAL KJELDAHL N MG/L	07506L NITROGEN TOTAL AMMONIA N MG/L	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L	15103L PHOSPHORUS DISSOLVED P MG/L
SAMPLES(FLAGS)	0479	12(0)	12(0)	12(1)			6(0)	12(0)	12(0)
LOW		.15	.05	L.01			.1	.05	.025
HIGH		3.40	.52	1.80			.8	.34	.24
AVERAGE		.72	.148	.34*			.365	.12	.076
STD.DEV.		.87	.132	.47*			.281	.09	.066
PERCNT:10TH		.26	.06	.05				.05	.032
25TH		.34	.070	.16			.1	.07	.038
MEDIAN 50TH		.49	.095	.22			.295	.08	.056
75TH		.60	.155	.34			.60	.17	.073
90TH		1.0	.27	.43				.24	.180
SECONDARY CODE				10F					03F

	SUBM ID	15256L PHOSPHORUS DISSOLVED ORTHO PO4 P MG/L	15413L PHOSPHORUS TOTAL PHOSPHATE P MG/L	06902L CARBON ORGANIC PARTICULATE C MG/L	06151L CARBON DISSOLVED INORGANIC C MG/L	06101L CARBON DISSOLVED ORGANIC C MG/L	06051L CARBON TOTAL INORGANIC C MG/L	06001L CARBON TOTAL ORGANIC C MG/L	10401L RESIDUE NONFILTR. MG/L
SAMPLES(FLAGS)	0479		12(0)	12(0)		10(1)			12(0)
LOW			.049	.37		L1.0			2.
HIGH			.34	8.4		7.0			162.
AVERAGE			.124	1.405		2.7*			26.
STD.DEV.			.091	2.247		1.7*			44.
PERCNT:10TH			.053	.390		1.4*			4.
25TH			.069	.405		2.0			5.
MEDIAN 50TH			.085	.575		2.1			11.
75TH			.165	1.300		3.2			24.
90TH			.24	1.7		5.5			36.
SECONDARY CODE			06L			04F 04L			

	SUBM ID	10501L RESIDUE FIXED NONFILTR. MG/L	36002L COLIFORMS TOTAL MF NO/100ML	36012L COLIFORMS FECAL MF NO/100ML	36102L STREP. FECAL MF NO/100ML	06711L CHLORO - PHYLL A MG/L	08201L OXYGEN BIOCHEM. DEMAND-BOD O2 MG/L	06510P AROMATIC HYDROC. UG/L	06521L OIL AND GREASE MG/L
SAMPLES(FLAGS)	0479		8(0)	9(1)	4(0)				
LOW			80.	L10.	30.				
HIGH			7400.	385.	155.				
AVERAGE			1968.	132.*	78.				
STD.DEV.			2491.	146.*	56.				
PERCNT:10TH									
25TH			340.	17.	37.				
MEDIAN 50TH			1090.	60.	63.				
75TH			2700.	250.	119.				
90TH									
SECONDARY CODE			02F	12F	02F				

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NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05EC0005 LAT. 54D 0M 9S LONG. 112D 23M 54S PR 4 UTM 12 408400E 5984500N FOR JAN 13, 1981 TO DEC 08, 1981
NORTH SASKATCHEWAN RIVER AT PAKAN, ALBERTA

	SUBM	26304P IRON EXTRBLE.	26104L IRON DISSOLVED	56301P BARIUM EXTRBLE.	25104L MANGANESE DISSOLVED	25304P MANGANESE EXTRBLE.	48302P CADMIUM EXTRBLE.	27302P COBALT EXTRBLE.	27020P COBALT TOTAL RECOVERABLE
		FE	FE	BA	MN	MN	CD	CO	CO
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0479		12(9)		12(10)				4(2)
LOW			L.04		L.01				L.002
HIGH			.08		.03				.010
AVERAGE			.05*		.01*				.004*
STD.DEV.			.01*		.01*				.004*
PERCNT:10TH			L.04		L.01				
25TH			L.04		L.01				L.002
MEDIAN 50TH			L.04		L.01				.002*
75TH			.05*		L.01				.006
90TH			.07		.03				
SECONDARY CODE			04F		04F				

	SUBM	30020P ZINC TOTAL RECOVERABLE	30305P ZINC EXTRBLE.	23302P VANADIUM EXTRBLE.	23020P VANADIUM TOTAL RECOVERABLE	34102L SELENIUM DISSOLVED	56020P BARIUM TOTAL RECOVERABLE	80313P MERCURY EXTRACTABLE	80011P MERCURY TOTAL
		ZN	ZN	V	VA	SE	BA	HG	HG
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L
SAMPLES(FLAGS)	0479	3(0)			4(2)	12(9)	2(0)		10(9)
LOW		.006			L.001	L.0005	.05		L.02
HIGH		.010			.018	.0011	.06		.03
AVERAGE		.008			.005*	.0006*	.06		.02*
STD.DEV.		.002			.009*	.0002*	.01		.00*
PERCNT:10TH						L.0005			L.02
25TH					L.001	L.0005			L.02
MEDIAN 50TH		.007			.001*	L.0005	.06		L.02
75TH					.010	.0005*			L.02
90TH						.0010			.02*
SECONDARY CODE						02F			

	SUBM	47301P SILVER EXTRBLE.	13305P ALUMINUM EXTRBLE.	04301P BERYLLIUM EXTRBLE.	24302P CHROMIUM EXTRBLE.	05105L BORON DISSOLVED	42301L MOLYBDENUM EXTRBLE.	06604P CYANIDE TOTAL	18130L ALDRIN
		AG	AL	BE	CR	B	MO	CN	
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
SAMPLES(FLAGS)	0479	3(3)				7(0)			4(4)
LOW		L.004				.04			L.001
HIGH		L.004				.14			L.001
AVERAGE						.07			
STD.DEV.						.03			
PERCNT:10TH									
25TH						.05			L.001
MEDIAN 50TH		L.004				.06			L.001
75TH						.08			L.001
90TH									
SECONDARY CODE									

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NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05EC0005 LAT. 54D 0M 9S LONG. 112D 23M 54S PR 4 UTM 12 408400E 5984500N FOR JAN 13, 1981 TO OCT 06, 1981
NORTH SASKATCHEWAN RIVER AT PAKAN, ALBERTA

	SUBM ID	18075L ALPHA-BHC	18060L ALPHA-CHLORDANE	18065L GAMMA-CHLORDANE	18005L O,P-DDT	18010L P,P-DDD	18020L P,P-DDE	18000L P,P-DDT	18150L DIELDRIN
		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	0479	4(1)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)
LOW		L.001	L.003	L.002	L.001	L.002	L.001	L.004	L.002
HIGH		.006	L.003	L.002	L.001	L.002	L.001	L.004	L.002
AVERAGE		.003*							
STD.DEV.		.002*							
PERCNT:10TH									
25TH		.001*	L.003	L.002	L.001	L.002	L.001	L.004	L.002
MEDIAN 50TH		.003	L.003	L.002	L.001	L.002	L.001	L.004	L.002
75TH		.005	L.003	L.002	L.001	L.002	L.001	L.004	L.002
90TH									
SECONDARY CODE									

	SUBM ID	18050L ALPHA-ENDO-SULFHAN	18055L BETA-ENDO-SULFHAN	18140L ENDRIN	18040L HEPTACHLOR	18045L HEPTACHLOR EPOXIDE	18070L GAMMA-BHC (LINDANE)	18030L P,P-METHOXY-CHLOR	18520P MCPA
		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	0479	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)
LOW		L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.200
HIGH		L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
AVERAGE									
STD.DEV.									
PERCNT:10TH									
25TH		L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.200
MEDIAN 50TH		L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.200
75TH		L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.200
90TH									
SECONDARY CODE									

	SUBM ID	18555P 2,4-DP	18500P 2,4-D	18510P 2,4,5-T	18550P 2,4-DB	18125L MIREX TOTAL	18164L ARCCLORS TOTAL (PCB'S)	18161L AROCLOR 1248 (PCB'S)	18160L AROCLOR 1254 (PCB'S)
		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	0479	4(4)	4(0)	4(2)	4(4)	4(4)	4(4)	1(1)	4(4)
LOW		L.004	.05	L.002	L.009	L.001	L.002	L.002	L.002
HIGH		L.004	.300	.040	L.009	L.001	L.002	L.002	L.002
AVERAGE			.133	.013*					
STD.DEV.			.114	.018*					
PERCNT:10TH									
25TH		L.004	.065	L.002	L.009	L.001	L.002		L.002
MEDIAN 50TH		L.004	.090	.006*	L.009	L.001	L.002		L.002
75TH		L.004	.200	.025	L.009	L.001	L.002		L.002
90TH									
SECONDARY CODE									

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NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05EC0005 LAT. 54D 0M 9S LONG. 112D 23M 54S PR 4 UTM 12 408400E 5984500N FOR JAN 13, 1981 TO OCT 06, 1981
NORTH SASKATCHEWAN RIVER AT PAKAN, ALBERTA

	18600L PICLORAM (TORDON)	18162L AROCLOR 1260 (PCB'S)	18190P GUTHION	18195P AZIN-PHOSETHYL	18205P IMIDAN	18215P DISULFOTON	18230P CRUFOMATE	18240P PARTHION
SUBM ID	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS) 0479	1(1)	4(4)	4(4)	4(4)	4(4)	2(2)	4(4)	4(4)
LOW	L.20	L.005	L.5	L.20	L.20	L.020	L.20	L.02
HIGH	L.20	L.005	L.5	L.20	L.20	L.02	L.20	L.02
AVERAGE								
STD.DEV.								
PERCNT:10TH								
25TH		L.005	L.5	L.20	L.20		L.20	L.02
MEDIAN 50TH		L.005	L.5	L.20	L.20	L.020	L.20	L.02
75TH		L.005	L.5	L.20	L.20		L.20	L.02
90TH								
SECONDARY CODE	01P							

	18245P PARATHION-METHYL	18250P MALATHION	18260P FENCHLORPHOS (RONNEL)	18270P DIAZIONON	18300P PHORATE	18310P ETHION	18320P CARBO-PHENOTHION	18540P SILVEX
SUBM ID	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS) 0479	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)
LOW	L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
HIGH	L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
AVERAGE								
STD.DEV.								
PERCNT:10TH								
25TH	L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
MEDIAN 50TH	L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
75TH	L.02	L.05	L.02	L.02	L.02	L.02	L.02	L.004
90TH								
SECONDARY CODE								

	33104L ARSENIC DISSOLVED	29305P COPPER EXTRBLE.	29020P COPPER TOTAL RECOVERABLE	28302P NICKEL EXTRBLE.	28020P NICKEL TOTAL RECOVERABLE	48020P CADMIUM TOTAL RECOVERABLE	82302P LEAD EXTRBLE.	82020P LEAD TOTAL RECOVERABLE
SUBM	AS	CU	CU	NI	NI	CD	PB	PB
ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS) 0479	1(1)		4(1)		3(1)	2(2)		2(2)
LOW	L.0005		L.001		L.002	L.001		L.004
HIGH	L.0005		.004		.006	L.001		L.004
AVERAGE			.002*		.004*			
STD.DEV.			.001*		.002*			
PERCNT:10TH								
25TH			.001*					
MEDIAN 50TH			.002		.004	L.001		L.004
75TH			.003					
90TH								
SECONDARY CODE								

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NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00AL05EC0005 LAT. 54D 0M 9S LONG. 112D 23M 54S PR 4 UTM 12 408400E 5984500N FOR JAN 13, 1981 TO DEC 08, 1981
NORTH SASKATCHEWAN RIVER AT PAKAN, ALBERTA

SUBM ID	17811L HEXACHLORO-BENZENE	06535P PHENOLIC MATERIAL PHENOL	06717L CHLORO-PHYLL A	07904L NITROGEN PARTICULATE (CALCD.) N	18159L AROCLOR 1242 (PCB'S)	10122L TOTAL ALKALINITY	54502L CARBON FIXATION EPILITHON C	06720L CHLOROPHYLL -A- PHYTOPLANKTON
	UG/L	MG/L	MG/L	MG/L	UG/L	MEQ/L	MG/M2/HR	MG/M3
SAMPLES(FLAGS) 0479	4(4)	12(7)	12(1)		3(3)			
LOW	L.001	L.001	L.001		L.002			
HIGH	L.001	.002	.010		L.002			
AVERAGE		.001*	.0064*					
STD.DEV.		.000*	.0036*					
PERCNT:10TH		L.001	.0010					
25TH	L.001	L.001	.0030					
MEDIAN 50TH	L.001	L.001	.0075		L.002			
75TH	L.001	.001	.0095					
90TH		.002	.010					
SECONDARY CODE			17P					

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NAQUADAT SUMMARY REPORT AUG 22, 1983
FEDERAL FILE DATA

STATION 00SA05EF0001 LAT. 53D 31M 0S LONG. 109D 36M 39S PR 4 UTM 12 592100E 5930400N FOR JAN 21, 1981 TO DEC 02, 1981
NORTH SASKATCHEWAN RIVER AT HWY 3 BRIDGE, SASKATCHEWAN

	SUBM ID	10151L ALKALINITY PHENOL PHTHALEIN CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	20103L CALCIUM DISSOLVED CA MG/L	12102L MAGNESIUM DISSOLVED MG MG/L	12101L MAGNESIUM DISSOLVED (CALCD.) MG MG/L	19103L POTASSIUM DISSOLVED K MG/L	11103L SODIUM DISSOLVED NA MG/L	17206L CHLORIDE DISSOLVED CL MG/L
SAMPLES(FLAGS)	0462	11(0)	11(0)	11(0)	11(0)		11(0)	11(0)	11(0)
LOW		.0	123.0	40.00	11.8		.9	4.7	1.4
HIGH		7.	155.0	54.20	15.6		2.8	25.0	26.0
AVERAGE		1.7	134.6	45.80	14.0		1.29	9.50	6.3
STD.DEV.		2.7	9.8	4.05	1.4		.62	6.47	7.5
PERCNT:10TH		.0	125.0	42.40	12.4		.9	5.0	1.4
25TH		.0	125.0	43.00	13.2		.9	5.4	2.4
MEDIAN 50TH		.0	134.0	44.60	13.4		1.0	6.7	3.8
75TH		3.7	143.0	48.90	15.3		1.3	14.	4.8
90TH		6.	144.	50.00	15.5		2.2	17.0	15.0
SECONDARY CODE									

	SUBM ID	09105L FLUORIDE DISSOLVED F MG/L	14102L SILICA REACTIVE SIO2 MG/L	16306L SULPHATE DISSOLVED SO4 MG/L	02061S TEMPERATURE OF WATER DEG.C.	10301L PH PH UNITS	10301S PH PH UNITS	02041L SPECIFIC CONDUCT. US/CM	02041S SPECIFIC CONDUCT. US/CM
SAMPLES(FLAGS)	0462	11(0)	11(0)	11(0)	11(0)	11(0)		11(0)	11(0)
LOW		.07	.2	24.	.0	7.5		305.	284.
HIGH		.24	6.4	51.	20.5	8.9		533.	492.
AVERAGE		.15	3.35	37.6	7.59			376.	353.
STD.DEV.		.04	2.18	8.2	8.58			67.	54.
PERCNT:10TH		.12	.6	29.	.5	7.7		328.	322.
25TH		.13	1.2	32.	.5	7.9		331.	327.
MEDIAN 50TH		.15	3.8	38.	1.5	8.2		351.	334.
75TH		.16	5.1	44.	18.	8.6		401.	365.
90TH		.18	5.6	46.	19.5	8.8		452.	390.
SECONDARY CODE			05L		61F				41F

	SUBM ID	10602L HARDNESS TOTAL (CALCD.) CACO3 MG/L	06201L BICARBONT. (CALCD.) HCO3 MG/L	06301L CARBONATE (CALCD.) CO3 MG/L	02073L TURBIDITY JTU	02073S TURBIDITY JTU	02011L COLOUR APPARENT REL. UNITS	08101P OXYGEN DISSOLVED DO O2 MG/L	07110L NITROGEN DISSOLVED NO3 & NO2 N MG/L
SAMPLES(FLAGS)	0462	11(0)	11(0)	11(0)	11(0)	11(1)	3(0)	11(0)	
LOW		148.5	144.	0.	2.5	.3	5.	7.4	
HIGH		199.2	189.	8.	250.0	G1000.	20.	14.7	
AVERAGE		171.9	160.	2.	28.5	96.9*	10.	10.6	
STD.DEV.		15.2	13.	3.	73.6	299.6*	9.	2.2	
PERCNT:10TH		156.9	149.	0.	2.6	1.6		8.4	
25TH		162.5	150.	0.	3.6	2.2		8.8	
MEDIAN 50TH		165.7	157.	0.	4.5	4.8	5.	10.5	
75TH		186.3	168.	4.	14.	12.		13.2	
90TH		187.0	174.	7.	18.0	28.0		13.2	
SECONDARY CODE						73F			

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NORTH SASKATCHEWAN RIVER AT HWY 3 BRIDGE, SASKATCHEWAN

		07651L	07902L	07110L	07105L	07001L	07506L	15406L	15103L
		NITROGEN	NITROGEN	NITROGEN	NITROGEN	NITROGEN	NITROGEN	PHOSPHOROUS	PHOSPHORUS
		DISSOLVED	PARTICUL.	DISSOLVED	DISSOLVED	TOTAL	TOTAL	TOTAL	DISSOLVED
				NO3 & NO2	NO3 & NO2	KJELDAHL	AMMONIA	PHOSPHATE	
	SUBM	N	N	N	N	N	N	P	P
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0462	11(0)	11(2)	11(3)			8(8)	11(0)	10(0)
LOW		.10	L.01	L.01			L.1	.03	.005
HIGH		1.20	1.40	.80			L.1	.75	.090
AVERAGE		.50	.238*	.26*				.14	.048
STD.DEV.		.31	.402*	.29*				.20	.030
PERCNT:10TH		.16	L.01	L.01				.07	.011
25TH		.28	.04	L.01			L.100	.08	.021
MEDIAN 50TH		.43	.08	.22			L.100	.09	.057
75TH		.64	.28	.54			L.100	.10	.073
90TH		.80	.37	.70				.11	.082
SECONDARY CODE				10F					03F

		15256L	15413L	06902L	06151L	06101L	06051L	06001L	10401L
		PHOSPHORUS	PHOSPHORUS	CARBON	CARBON	CARBON	CARBON	CARBON	RESIDUE
		DISSOLVED	TOTAL	ORGANIC	DISSOLVED	DISSOLVED	TOTAL	TOTAL	NONFILTR.
		ORTHO PO4	PHOSPHATE	PARTICULATE	INORGANIC	ORGANIC	INORGANIC	ORGANIC	
	SUBM	P	P	C	C	C	C	C	
	ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0462		11(0)	10(0)		11(0)			11(0)
LOW			.034	.11		2.0			2.
HIGH			.750	20.30		6.4			716.
AVERAGE			.142	2.861		3.5			76.
STD.DEV.			.202	6.192		1.5			213.
PERCNT:10TH			.070	.145		2.1			3.
25TH			.076	.30		2.2			3.
MEDIAN 50TH			.086	.520		3.0			4.
75TH			.095	2.3		4.3			30.
90TH			.110	11.450		5.9			51.
SECONDARY CODE			06L			04F 04L			

		10501L	36002L	36012L	36102L	06711L	08201L	06510P	06521L
		RESIDUE	COLIFORMS	COLIFORMS	STREP.	CHLORO -	OXYGEN	AROMATIC	OIL AND
		FIXED	TOTAL	FECAL	FECAL	PHYLL A	BIOCHEM.	HYDROC.	GREASE
		NONFILTR.					DEMAND-BOD		
	SUBM		MF	MF	MF		O2		
	ID	MG/L	NO/100ML	NO/100ML	NO/100ML	MG/L	MG/L	UG/L	MG/L
SAMPLES(FLAGS)	0462	9(0)	11(0)	11(2)				11(11)	
LOW		1.	2.	L2.				L1.0	
HIGH		660.	6400.	920.				L1.0	
AVERAGE		81.	663.	106.*					
STD.DEV.		218.	1905.	273.*					
PERCNT:10TH			4.	L2.				L1.0	
25TH		2.	18.	2.				L1.0	
MEDIAN 50TH		2.	70.	16.				L1.0	
75TH		9.	220.	43.				L1.0	
90TH			300.	140.				L1.0	
SECONDARY CODE			02F	12F					

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STATION 00SA05EF0001 LAT. 53D 31M 0S LONG. 109D 36M 39S PR 4 UTM 12 592100E 5930400N FOR JAN 21, 1981 TO DEC 02, 1981
NORTH SASKATCHEWAN RIVER AT HWY 3 BRIDGE, SASKATCHEWAN

	SUBM ID	26304P IRON EXTRBLE.	26104L IRON DISSOLVED	56301P BARIUM EXTRBLE.	25104L MANGANESE DISSOLVED	25304P MANGANESE EXTRBLE.	48302P CADMIUM EXTRBLE.	27302P COBALT EXTRBLE.	27020P COBALT TOTAL RECOVERABLE
		FE	FE	BA	MN	MN	CD	CO	CO
		MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES(FLAGS)	0462		11(8)		11(9)				11(7)
LOW			L.04		L.01				L.002
HIGH			.06		.02				.010
AVERAGE			.04*		.01*				.003*
STD.DEV.			.01*		.00*				.002*
PERCNT:10TH			L.04		L.01				L.002
25TH			L.04		L.01				L.002
MEDIAN 50TH			L.04		L.01				L.002
75TH			.04		L.01				.002
90TH			.05		.01				.004
SECONDARY CODE			04F		04F				

	SUBM ID	30020P ZINC TOTAL RECOVERABLE	30305P ZINC EXTRBLE.	23302P VANADIUM EXTRBLE.	23020P VANADIUM TOTAL RECOVERABLE	34102L SELENIUM DISSOLVED	56020P BARIUM TOTAL RECOVERABLE	80313P MERCURY EXTRACTABLE	80011P MERCURY TOTAL
		ZN	ZN	V	VA	SE	BA	HG	HG
		MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	UG/L
SAMPLES(FLAGS)	0462	10(0)			11(7)	11(11)	11(2)		11(11)
LOW		.001			L.001	L.0005	L.05		L.02
HIGH		.082			.032	L.0005	.29		L.02
AVERAGE		.013			.004*		.08*		
STD.DEV.		.024			.009*		.07*		
PERCNT:10TH		.002			L.001	L.0005	L.05		L.02
25TH		.004			L.001	L.0005	.05		L.02
MEDIAN 50TH		.006			L.001	L.0005	.06		L.02
75TH		.008			.001	L.0005	.07		L.02
90TH		.045			.002	L.0005	.08		L.02
SECONDARY CODE						02F			

	SUBM ID	47301P SILVER EXTRBLE.	13305P ALUMINUM EXTRBLE.	04301P BERYLLIUM EXTRBLE.	24302P CHROMIUM EXTRBLE.	05105L BORON DISSOLVED	42301L MOLYBDENUM EXTRBLE.	06604P CYANIDE TOTAL	18130L ALDRIN
		AG	AL	BE	CR	B	MO	CN	
		MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
SAMPLES(FLAGS)	0462		7(4)		7(7)	6(0)		11(1)	11(11)
LOW			L.06		L.015	.02		L.001	L.001
HIGH			4.30		L.015	.17		.015	L.001
AVERAGE			.681*			.10		.005*	
STD.DEV.			1.596*			.06		.005*	
PERCNT:10TH								.001	L.001
25TH			L.06		L.015	.02		.002	L.001
MEDIAN 50TH			L.06		L.015	.13		.002	L.001
75TH			.17		L.015	.14		.007	L.001
90TH								.013	L.001
SECONDARY CODE			02P						

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NORTH SASKATCHEWAN RIVER AT HWY 3 BRIDGE, SASKATCHEWAN

SUBM ID 0462	18075L ALPHA-BHC	18060L ALPHA-CHLORDANE	18065L GAMMA-CHLORDANE	18005L O,P-DDT	18010L P,P-DDD	18020L P,P-DDE	18000L P,P-DDT	18150L DIELDRIN
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	11(0)	11(11)	11(11)	11(11)	11(11)	11(11)	11(11)	11(11)
LOW	.001	L.003	L.002	L.001	L.002	L.001	L.004	L.002
HIGH	.007	L.003	L.002	L.001	L.002	L.001	L.004	L.002
AVERAGE	.003							
STD.DEV.	.002							
PERCNT:10TH	.001	L.003	L.002	L.001	L.002	L.001	L.004	L.002
25TH	.001	L.003	L.002	L.001	L.002	L.001	L.004	L.002
MEDIAN 50TH	.003	L.003	L.002	L.001	L.002	L.001	L.004	L.002
75TH	.005	L.003	L.002	L.001	L.002	L.001	L.004	L.002
90TH	.005	L.003	L.002	L.001	L.002	L.001	L.004	L.002
SECONDARY CODE								

SUBM ID 0462	18050L ALPHA-ENDO-SULFHAN	18055L BETA-ENDO-SULFHAN	18140L ENDRIN	18040L HEPTACHLOR	18045L HEPTACHLOR EPOXIDE	18070L GAMMA-BHC (LINDANE)	18030L P,P-METHOXY-CHLOR	18520P MCPA
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	11(11)	11(11)	11(11)	11(11)	11(11)	11(8)	11(11)	11(11)
LOW	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
HIGH	L.001	L.003	L.002	L.001	L.002	.002	L.010	L.2
AVERAGE						.001*		
STD.DEV.						.000*		
PERCNT:10TH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
25TH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
MEDIAN 50TH	L.001	L.003	L.002	L.001	L.002	L.001	L.010	L.2
75TH	L.001	L.003	L.002	L.001	L.002	.002	L.010	L.2
90TH	L.001	L.003	L.002	L.001	L.002	.002	L.010	L.2
SECONDARY CODE								

SUBM ID 0462	18555P 2,4-DP	18500P 2,4-D	18510P 2,4,5-T	18550P 2,4-DB	18125L MIREX TOTAL	18164L ARCCLORS TOTAL (PCB'S)	18161L AROCLOR 1248 (PCB'S)	18160L AROCLOR 1254 (PCB'S)
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	11(11)	11(3)	11(9)	11(10)	11(11)	10(10)	3(3)	11(11)
LOW	L.004	L.004	L.002	L.009	L.001	L.002	L.002	L.002
HIGH	L.004	.500	.030	.03	L.001	L.002	L.002	L.002
AVERAGE		.140*	.007*	.011*				
STD.DEV.		.191*	.011*	.006*				
PERCNT:10TH	L.004	L.004	L.002	L.009	L.001	L.002		L.002
25TH	L.004	L.004	L.002	L.009	L.001	L.002		L.002
MEDIAN 50TH	L.004	.050	L.002	L.009	L.001	L.002	L.002	L.002
75TH	L.004	.400	L.002	L.009	L.001	L.002		L.002
90TH	L.004	.400	.030	L.009	L.001	L.002		L.002
SECONDARY CODE								

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NORTH SASKATCHEWAN RIVER AT HWY 3 BRIDGE, SASKATCHEWAN

	SUBM ID	18600L PICLORAM (TORDON)	18162L AROCLOR 1260 (PCB'S)	18190P GUTHION	18195P AZIN-PHOSETHYL	18205P IMIDAN	18215P DISULFOTON	18230P CRUFOMATE	18240P PARTHION
		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	0462	11(11)	11(11)						
LOW		L.2	L.005						
HIGH		L.2	L.005						
AVERAGE									
STD.DEV.									
PERCNT:10TH		L.2	L.005						
25TH		L.2	L.005						
MEDIAN 50TH		L.2	L.005						
75TH		L.2	L.005						
90TH		L.2	L.005						
SECONDARY CODE		01P							

	SUBM ID	18245P PARATHION-METHYL	18250P MALATHION	18260P FENCHLORPHOS (RONNEL)	18270P DIAZIONON	18300P PHORATE	18310P ETHION	18320P CARBO-PHENOTHION	18540P SILVEX
		UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
SAMPLES(FLAGS)	0462								11(11)
LOW									L.004
HIGH									L.004
AVERAGE									
STD.DEV.									
PERCNT:10TH									L.004
25TH									L.004
MEDIAN 50TH									L.004
75TH									L.004
90TH									L.004
SECONDARY CODE									

	SUBM ID	33104L ARSENIC DISSOLVED	29305P COPPER EXTRBLE.	29020P COPPER TOTAL RECOVERABLE	28302P NICKEL EXTRBLE.	28020P NICKEL TOTAL RECOVERABLE	48020P CADMIUM TOTAL RECOVERABLE	82302P LEAD EXTRBLE.	82020P LEAD TOTAL RECOVERABLE
		AS MG/L	CU MG/L	CU MG/L	NI MG/L	NI MG/L	CD MG/L	PB MG/L	PB MG/L
SAMPLES(FLAGS)	0462			11(3)		10(4)	11(10)		11(7)
LOW				L.001		L.002	L.001		L.004
HIGH				.025		.036	.001		.014
AVERAGE				.004*		.008*	.001*		.005*
STD.DEV.				.007*		.010*	.000*		.003*
PERCNT:10TH				L.001		L.002	L.001		L.004
25TH				L.001		L.002	L.001		L.004
MEDIAN 50TH				.002		.005	L.001		L.004
75TH				.003		.009	L.001		.004
90TH				.005		.024	L.001		.008
SECONDARY CODE									

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NORTH SASKATCHEWAN RIVER AT HWY 3 BRIDGE, SASKATCHEWAN

	SUBM ID	17811L HEXACHLORO-BENZENE UG/L	06535P PHENOLIC MATERIAL PHENOL MG/L	06717L CHLORO-PHYLL A MG/L	07904L NITROGEN PARTICULATE (CALCD.) N MG/L	18159L AROCLOR 1242 (PCB'S) UG/L	10122L TOTAL ALKALINITY MEQ/L	54502L CARBON FIXATION EPILITHON C MG/M2/HR	06720L CHLOROPHYLL -A- PHYTOPLANKTON MG/M3
SAMPLES(FLAGS)	0462	11(11)	10(4)	11(1)		8(8)			
LOW		L.001	L.001	L.001		L.002			
HIGH		L.001	.005	.040		L.002			
AVERAGE			.002*	.0117*					
STD.DEV.			.001*	.0150*					
PERCNT:10TH		L.001	L.001	.001					
25TH		L.001	L.001	.001		L.002			
MEDIAN 50TH		L.001	.002	.004		L.002			
75TH		L.001	.002	.020		L.002			
90TH		L.001	.004	.04					
SECONDARY CODE				17P					

	SUBM ID	06721L CHLOROPHYLL -A- EPILITHON MG/M2	97325L NET SOLAR RADIATION (RF4) MEGAJOULE/M2	18521L MCPB UG/L	18530L DIACAMBA UG/L	10701P SURFACT. N-ALKYL SULPHNTS. LAS MG/L	06500P HYDROCARBONS (ALKANES) MG/L	18180L BARBAN UG/L
SAMPLES(FLAGS)	0462					10(7)	11(11)	
LOW						L.01	L1.0	
HIGH						.02	L1.0	
AVERAGE						.01*		
STD.DEV.						.00*		
PERCNT:10TH						L.01	L1.0	
25TH						L.01	L1.0	
MEDIAN 50TH						L.01	L1.0	
75TH						.01	L1.0	
90TH						.02	L1.0	
SECONDARY CODE								

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APPENDIX "B"

Miscellaneous copies of portions of reports which illustrates the types of studies and controls undertaken and illustrate the progress of pollution control.

WATER QUALITY CRITERIA - NORTH SASKATCHEWAN RIVER AND THE SASKATCHEWAN RIVER, MAY 29, 1967

The criteria outlined below are intended as a guide for the control of the quality of waste water released to the rivers (recognizing the uses made of the river).

The current uses of the North Saskatchewan River in Alberta and Saskatchewan and the subsequent Saskatchewan River in Saskatchewan and Manitoba are as follows:

- source of municipal domestic water supply;
- irrigation - limited to minor market garden use;
- industrial cooling and process water requirements;
- salt (NaCl) solution - mining requirements (Alberta only);
- fish and wildlife propagation - sports fishing (commercial fishing - Manitoba only);
- recreation - limited use except for boating, fishing, hiking, picnic areas, and camping;
- hydro-electric power generation; and
- waste water disposal - industrial and municipal.

Water Quality Requirements are those necessary to allow the beneficial uses to be achieved after the water from the rivers is treated in a manner equal to that normally required to remove naturally occurring materials detrimental to that use. It is recognized that within each province there will be certain areas of the rivers immediately downstream of waste water release points which may have water quality inferior to that outlined below and that use of water in these areas may be curtailed. It is also appreciated that the uses made

of the river will change in the future and, therefore, there will be a need to review these Water Quality Criteria periodically.

The Water Quality Criteria and/or an appropriate waste water quality for control purposes are as follows:

1. Bacteriological: Coliform bacteria criteria	
(a) Domestic water supply	- geometric mean MPN value not more 2,000 coliforms per 100 ml over any 30-day period; and not more than 20% of the samples in the 30-day period to exceed an MPN of 5,000/100 ml
(b) Market Gardening	- same as (a) above
(c) Recreation	- same as (a) above
2. Dissolved Oxygen:	- 5 mg/l minimum mean value in any 30-day period. Minimum single reading - 3 mg/l.
3. Odour: Threshold Odour Number (cold)	- 4 to 8 mean value in any 30-day period - 8 to 16 maximum reading (indicates questionable water quality)
4. Phenolics:	- 3 ppb maximum mean value, 30-day period. Not more than 20% of the samples to exceed 5 ppb in any 30-day period
5. Oil and Grease	- no irridescent sheen or visible floating material on water surface. (Basic effluent requirement - 25 mg/l of non-volatile oil)
6. Suspended Solids	- no visible suspended solids in the receiving water after dilution. (Basic effluent requirement - 100 ppm of total suspended solids, however, a normal (2 hour) settling of all waste water is required. Suspended solids removed in water treatment processes excepted)
7. Heavy Metals and other deleterious substances	- less than the concentration generally accepted (e.g. current U.S.P.H.S. published standards) for domestic water supplies

SUMMARY REPORT

NORTH SASKATCHEWAN RIVER

Pollution Survey

1969 - 1970

INTRODUCTION

The North Saskatchewan River serves as a source of water supply and a receiving stream for the wastes of many industries and municipalities. This report summarizes the results of approximately 100 samples taken mainly during the critical winter months, to assess the river water quality with respect to pollutional loads. The following locations were used for sampling (Figure 1):'

		Frequency of Sampling
NS1	Brazeau Reservoir Discharge	Once a Month
NS2	Drayton Valley	Once a Month
NS3	Devon Bridge	Once a Month
NS4	105 Street Bridge (Edmonton)	Twice a Montn
NS5	Fort Saskatchewan Bridge	Weekly
NS7	Waskatenau	Bi-Weekly
NS8	Duvernay Bridge	Bi-Weekly
NS9	Elk Point Bridge	Bi-Weekly
N-10	Lindbergh	Bi-Weekly
N-11	Lloydminster Ferry	Bi-Weekly

Automatic instrumentation situated at Vinca Ferry continuously monitored the North Saskatchewan River for Dissolved Oxygen, pH, Temperature, Conductivity, and Oxidation Reduction potential.

An automatic [illegible] was located at the Canadian Salt Co. Ltd., Plant at Lindbergh for the winter season.

The major potential load to the North Saskatchewan River occurs at or near Edmonton and a somewhat greater sampling frequency was conducted downstream.

All industrial and municipal samples represent 24 - hour composites and were co-ordinated with river sampling data in all cases.

NII NORTH SASKATCHEWAN RIVER AT LLOYDMINSTER FERRY 1968-69

DAY MONTH YEAR	25 JUL 1968	2 OCT 1968	17 OCT 1968	14 NOV 1968	27 NOV 1968	12 DEC 1958	15 JAN 1969
COMPOSITE OR GRAB SAMPLE	G	G	G	G	G	G	G
INITIAL SAMPLING TIME	1230	1300	800	730	1530	1400	1530
TEMPERATURE, DEG.CENT.	17.5	9.0	3.0	0.0	0.0	0.0	0.0
BAROMETRIC PRES. IN.HG	28.42	28.48	28.20	28.25	28.40	*0.00	28.60
DISSOLVED OXYGEN, MG/L	7.8	12.1	12.5	13.2	12.1	9.8	8.0
PERCENT SATURATION	86.	110.	98.	96.	87.	*00.	57.
BIOCHEM. OX. DEMAND MG/L	2.1	1.5	1.0	0.9	1.1	1.2	0.9
HYDROGEN ION CONC.,PH	7.8	8.5	8.5	8.0	8.2	8.1	8.3
ALKALINITY MG/L	115	142	139	166	196	192	174
THRESHOLD ODOR NO.,TYPE	8 M	8 C	8 M	4 M	4 M	8 M	16 C
TOTAL SOLIDS MG/L	344	254	262	324	292	416	326
IGNITION LOSS MG/L	100	110	40	92	54	102	122
TURBIDITY AS SIO2 MG/L	132	19	7	8	16	10	18
TOTAL HARDNESS MG/L	128	164	150	254	186	230	220
CHLORIDES MG/L	70	9	12	19	29	29	31
AMMONIA NITROGEN MG/L	0.1	1.1	0.5	1.0	2.0	0.2	5.0
NITRATE NITROGEN MG/L	0.6	0.5	0.2	0.3	0.6	0.8	0.3
SULFATES AS SO4 MG/L	40	56	58	76	54	80	78
PHOSPHATES AS PO4 MG/L	0.7	0.3	0.3	0.2	0.5	0.6	0.9
PHENOLS PPB	3	0	2	3	4	3	0
OILS & GREASES MG/L	0.4	0.5	1.6	0.3	0.7	1.7	0.8
FLUORIDES MG/L	0.13	0.19	0.21	0.45	0.29	0.20	0.18
COLIFORM M.P.N./100ML.	920.	2.	8.	2.	0.	0.	0.
MPN OF E COLI/100ML.	5.	0.	2.	0.	0.	0.	0.
STANDARD PLATE COUNT/ML	260000	11000	8000	25000	150	*00000	13000
RIVER DISCHARGE C.F.S.	16900.	4260.	5620.	2450.	2750.	2080.	3580.
DETERGENTS		0.03		0.02		0.15	0.12

* DENOTES DATA NOT AVAILABLE

DAY MONTH YEAR	5 FEB 1969	26 FEB 1969	19 MAR 1969
COMPOSITE OR GRAB SAMPLE	G	G	G
INITIAL SAMPLING TIME	1345	1330	1330
TEMPERATURE, DEG.CENT.	0.0	0.0	0.0
BAROMETRIC PRES. IN.HG	27.95	28.20	28.19
DISSOLVED OXYGEN, MG/L	7.3	5.5	8.1
PERCENT SATURATION	54.	40.	59.
BIOCHEM. OX. DEMAND MG/L	1.1	1.2	0.7
HYDROGEN ION CONC.,PH	8.2	8.9	8.3
ALKALINITY MG/L	168	186	170
THRESHOLD ODOR NO.,TYPE	8 C	4 C	8 M
TOTAL SOLIDS MG/L	302	326	382
IGNITION LOSS MG/L	58	94	106
TURBIDITY AS SIO2 MG/L	6	6	4
TOTAL HARDNESS MG/L	186	196	198
CHLORIDES MG/L	26	30	36
AMMONIA NITROGEN MG/L	3.9	1.2	3.0
NITRATE NITROGEN MG/L	0.2	0.3	0.4
SULFATES AS SO4 MG/L	64	70	82
PHOSPHATES AS PO4 MG/L	0.8	0.8	0.7
PHENOLS PPB	1	*0	3
OILS & GREASES MG/L	5.2	1.6	0.5
FLUORIDES MG/L	0.18	0.19	0.19
COLIFORM M.P.N./100ML.	0.	2.	0.
MPN OF E COLI/100ML.	0.	2.	0.
STANDARD PLATE COUNT/ML	10	10	5500
RIVER DISCHARGE C.F.S.	3400.	1800.	2900.
DETERGENTS	0.04	0.06	.013

* DENOTES DATA NOT AVAILABLE

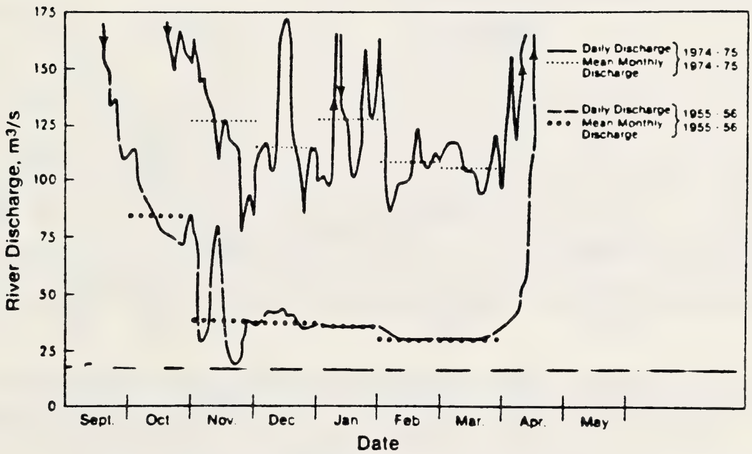
N11 NORTH SASKATCHEWAN RIVER AT LLOYDMINSTER FERRY 1969-70

	AVERAGE	MAXIMUM	MINIMUM	MEDIAN
DISSOLVED OXYGEN MG/L	9.73	14.00	6.40	9.20
BOD MG/L	1.44	2.60	0.40	1.50
HYDROGEN ION CONC.,PH	8.18	8.80	7.90	8.00
~~ALKALINITY MG/L~~	~~166.00~~	~~200.00~~	~~104.00~~	~~169.00~~
TOTAL RESIDUE MG/L	309.63	379.00	264.00	330.00
IGNITION LOSS MG/L	91.75	130.00	56.00	88.00
TURBIDITY AS SIO2 MG/L	6.75	28.00	2.00	3.00
~~TOTAL HARDNESS MG/L~~	~~201.33~~	~~222.00~~	~~164.00~~	~~206.00~~
CHLORIDES MG/L	15.13	27.00	6.00	14.00
. " ONIA NITROGEN MG/L	0.93	1.70	0.10	1.00
SULFATES AS SO4 MG/L	63.50	73.00	44.00	66.00
~~NITRATE NITROGEN MG/L~~	~~0.44~~	~~0.70~~	~~0.30~~	~~0.40~~
TOTAL PHOS.AS PO4 MG/L	0.55	1.30	0.10	0.40
PHENOLS PPB	3.14	8.00	0.00	2.00
OILS AND GREASES MG/L	4.66	20.00	0.20	1.70
~~FLUORIDES MG/L~~	~~0.24~~	~~0.56~~	~~0.11~~	~~0.22~~
COLIFORMS M.P.N./100ML	35.	130.	5.	23.
M.P.N. OF E COLI/100ML	2.	6.	0.	2.
STANDARD PLATE COUNT/ML	63600.	400000.	500.	4000.
~~DETERGENTS MG/L~~	~~0.13~~	~~0.20~~	~~0.00~~	~~0.10~~

TOTAL LOADINGS TO THE NORTH SASKATCHEWAN RIVER IN LBS/DAY

PARAMETER	Nov.1-2/71	Dec.14-15/71	Jan.10-12/72	Jan.30-Feb.3/72
Biochemical Oxygen Demand	26,800	34,200	25,500	28,900
Chemical Oxygen Demand	68,300	134,500	46,400	75,000
Alkalinity pp as $CaCO_3$	25,300	14,100	35,500	11,100
Total Alkalinity as $CaCO_3$	141,000	114,000	135,300	134,700
Total Residue	1,387,000	862,000	756,100	977,300
Ignition Loss	124,500	76,600	90,800	115,600
Nonfilterable Residue	21,100	27,300	32,300	66,400
Ignition Loss	10,900	20,100	10,500	39,700
Oil & Grease	3,140	2,790	4,150	3,110
Phenols	11	33	20	11
Total Phosphorous as PO_4	8,310	8,880	11,300	3,190
Ammonia Nitrogen	12,700	12,500	16,100	12,700
Nitrate Nitrogen	1,360	700	430	200
Chlorides	782,900	231,400	315,600	443,900
Sulphates	28,600	18,900	100,900	95,000
Hexavalent Chromium	5	9	39	29
Fluorides	18	24	7	17

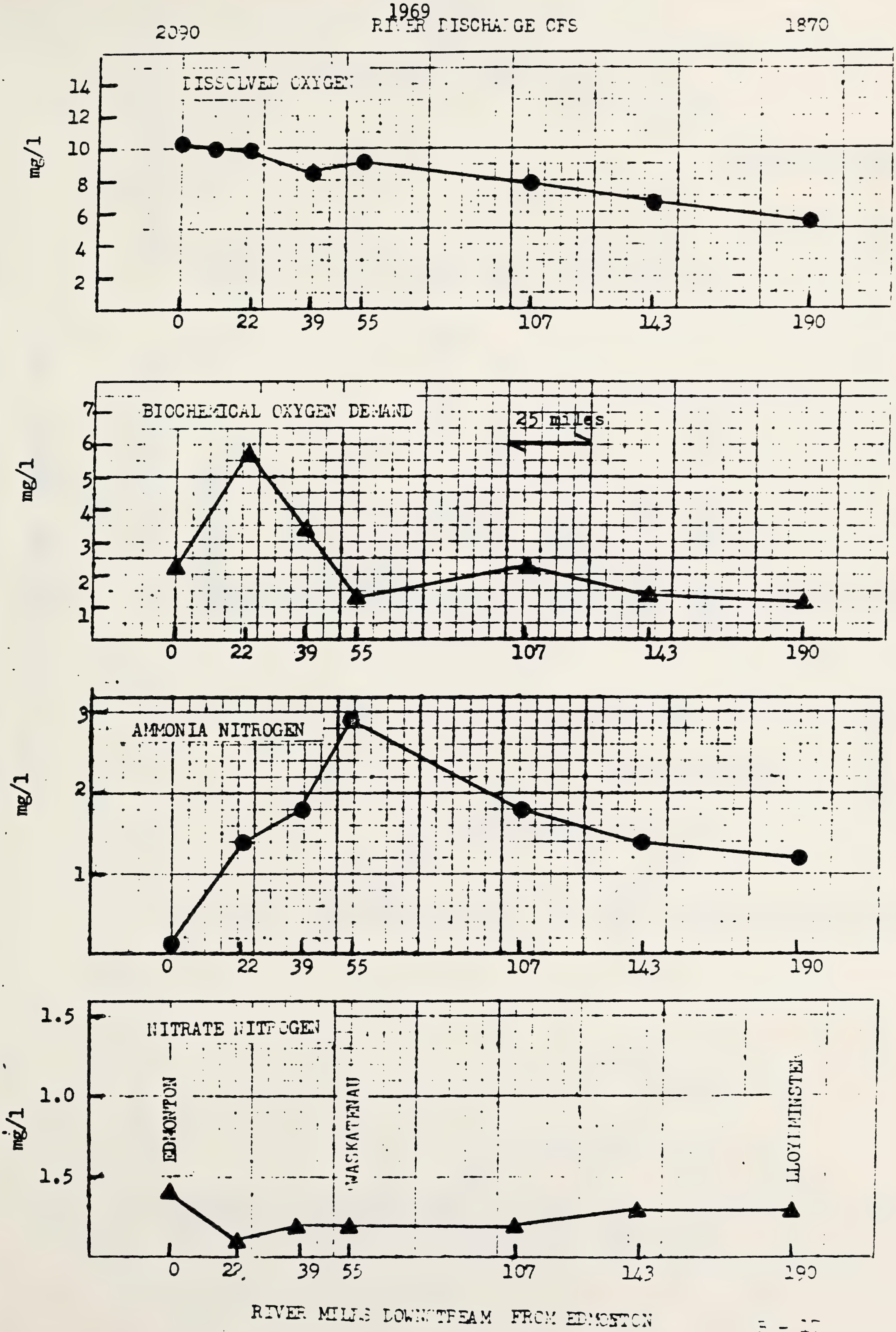
WINTER RIVER FLOWS - COMPARISON
OF 1954 - 55 AND 1974 - 75

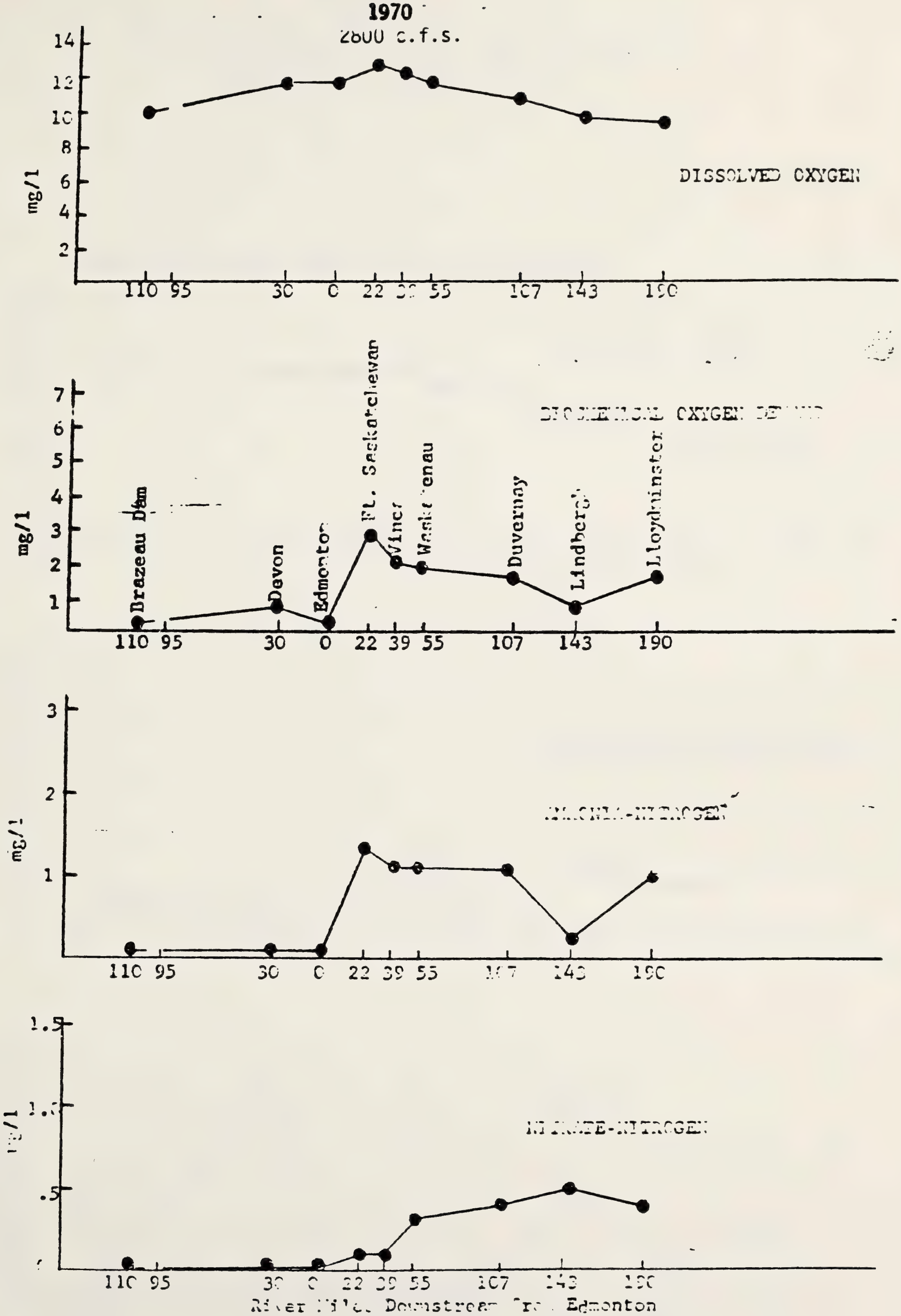


Winter Flow Variations in the North Saskatchewan River (Surface Water Data: Alberta, Water Survey of Canada)

Lower horizontal broken line on Figure 9 shows the minimum monthly average flow, prior to the construction of dams and reservoirs on the North Saskatchewan and the Brazeau Rivers.

NORTH SAKATCHEWAN RIVER SAMPLING RESULTS FEB. 26, 1969





North Saskatchewan River Sampling Results
March 17, 1970

1972
NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

February 29 - March 1, 1972